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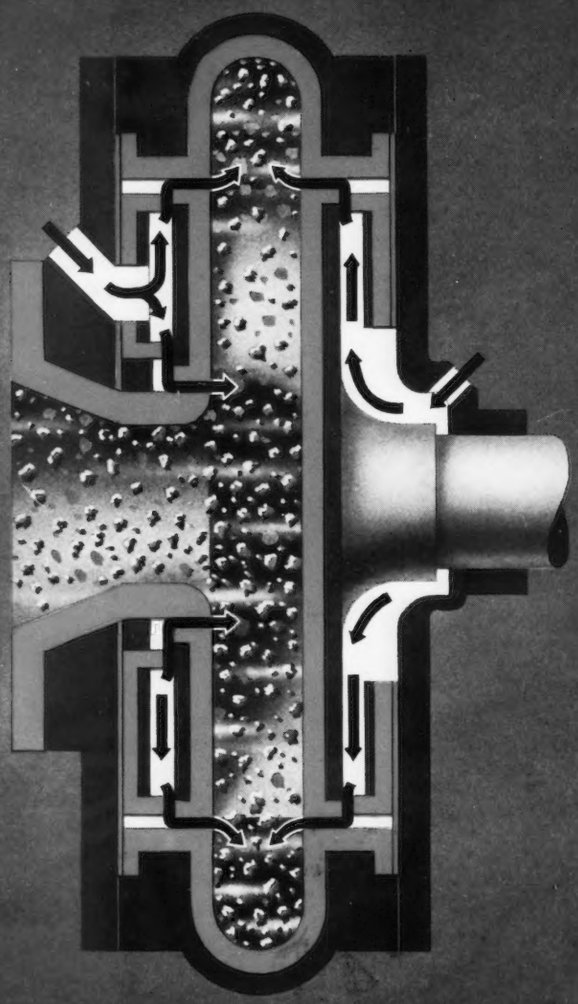

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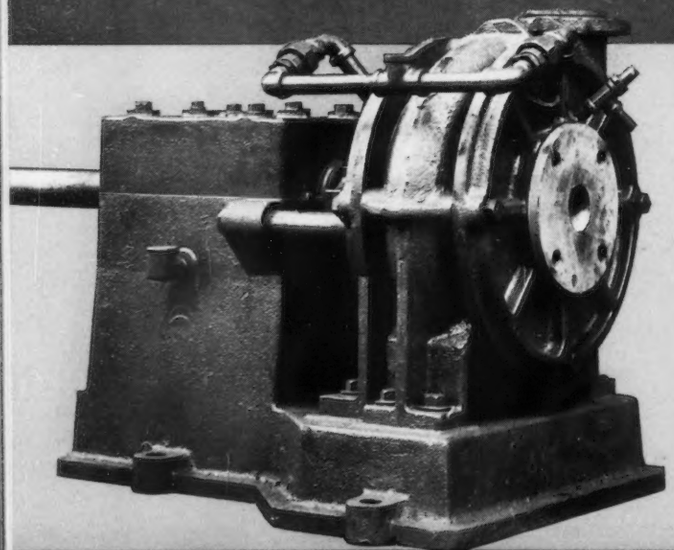

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"*E.&M.J.* METAL PRICES" will be published in chart form as a supplement to the January, 1935, number of *Engineering and Mining Journal*. The chart will be about 25x40 inches in size and will contain statistical and graphical records of prices of copper, lead, zinc, tin, and silver. Graphical records will run back to 1900. This will be the first chart published by *E.&M.J.* since January, 1932.

•

TREASURE HUNT. Lured by legends of silver treasure hidden in a cave in the Catskill Mountains, Palisades Interstate Park, New York, and guided by a faded map and travel directions, a "syndicate" financed a mining expedition into the country made famous by Washington Irving's story of Rip Van Winkle. Net result: Capture of the expedition by State police, and fines for defacing State property and illegal possession of explosives.

•

MELONES, Spanish for "melons," is the name of the little Mother Lode town that Carson Hill Gold gives as its mine address. A small wild gourd grows near by, whence presumably the name. Fancy had it also that the particles of the precious metal in the local ore were like this fruit's seed in shape. The story of Carson Hill, by John A. Burgess, will be published soon.

•

LEIPZIG'S TRADE FAIR is the most publicized institution of its kind. Agents announce it and never allow their hearers to forget. An exhibit of new inventions is now a permanent feature, devices heretofore unexploited being especially welcome. Those who fathered them are assured that if they cannot advertise or come to Leipzig, "their ideas will be presented by impartial experts." A heaven for inventors—and their imitators!

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PROFITS OF PROGRESS achieved through the agency of welding were depicted in a thrilling four-act play, thus entitled, at the recent convention of the International Acetylene Association in Pittsburgh. Decidedly not an industrial movie but a "legitimate drama," presented by a cast of seventeen. As the story goes, J. Malcolm Robinson pulls his company out of a hole by turning out a novel engine on short notice with the aid of acetylene. The real hero is the welding engineer, but Mr. Robinson gets the flowers.

•

CORDUROY, esteemed by mining men as proper fabric for clothes that wear, now takes another bow in its rôle of effective gold saver in metallurgical plants. No début but rather a re-entry in the grand manner into a formerly familiar field. Today's corduroy resembles the old-time stuff in the same degree that a Persian cat does an ordinary tom. M. W. von Bernewitz will tell about this revival in an early issue.

•

COPPER SULPHATE is used effectively to control micro-organisms in water supply, according to a pamphlet issued by Nichols Copper. The lethal dose varies according to the genus, beginning at 1 to 4 lb. per million gallons required to put various diatoms *hors de combat*. One may only speculate as to what killed the organisms that formed the great diatomite deposits of Southern California millions of years ago. Possibly old age.

•

PHILIPPINE ISLANDS may soon pass Alaska as a gold producer. Expected value of this year's production is ten million dollars, which is more than the 1933 value of Alaska's gold.

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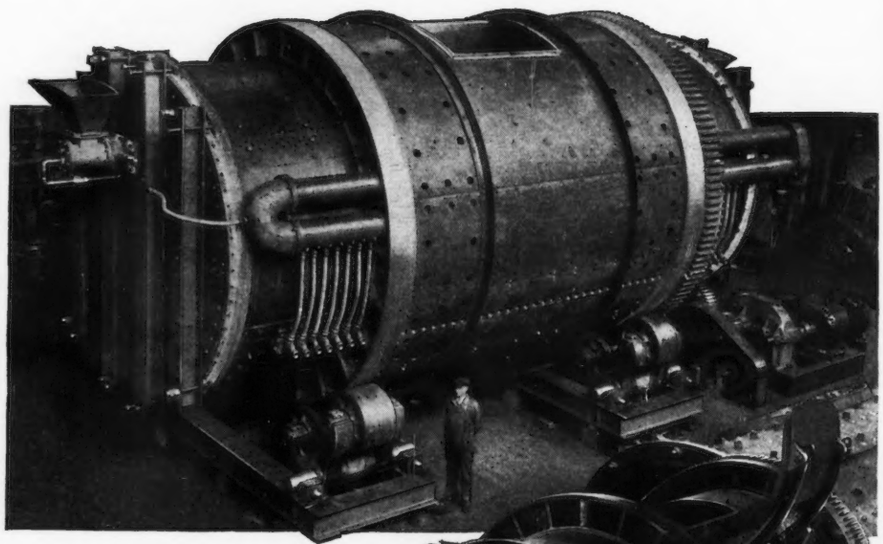
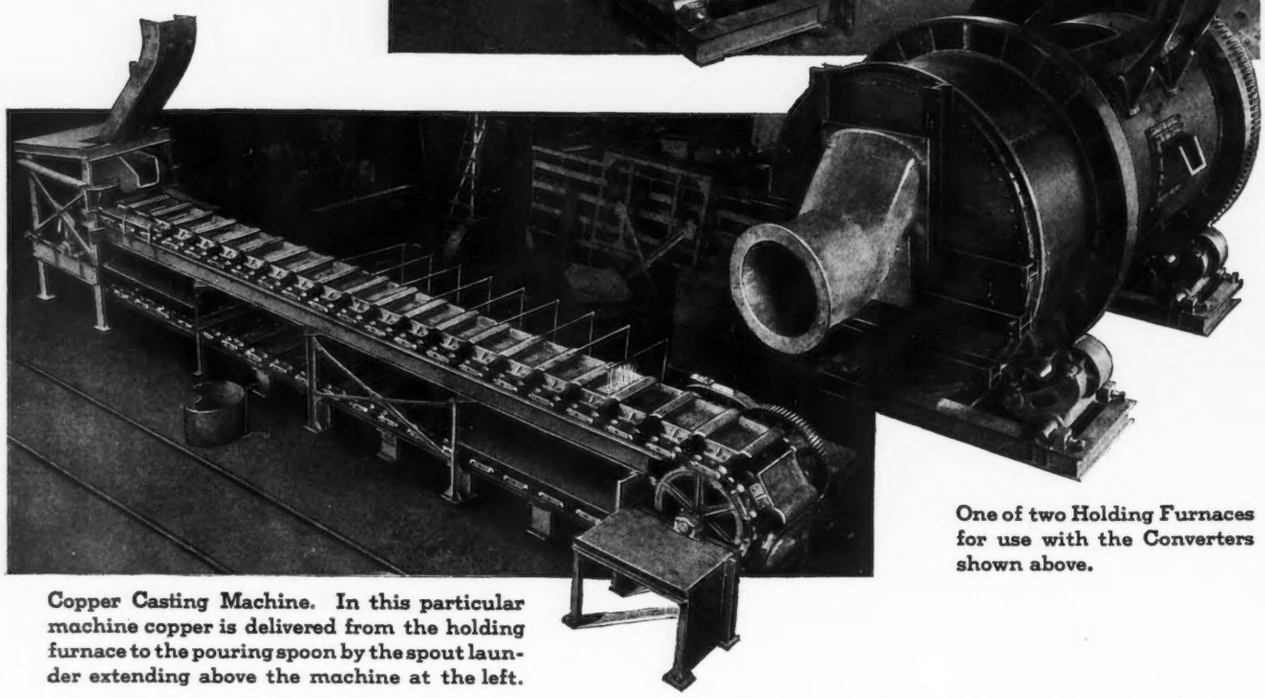
CONVERTERS...

Holding Furnaces

Casting Machines



One of three 13′ x 30′ Pierce-Smith Copper Converters for a South African Mine.



One of two Holding Furnaces for use with the Converters shown above.

Copper Casting Machine. In this particular machine copper is delivered from the holding furnace to the pouring spoon by the spout launder extending above the machine at the left.

PRESENT DAY metallurgical equipment has reached a high state of perfection and through over half a century Allis-Chalmers, with its predecessor companies, has unquestionably been one of the outstanding contributers to its development. Allis-Chalmers machinery is recognized as standard throughout the world. It is found in every mining district. No other organization is in a position to offer such a complete line of mechanical, and electrical, equipment . . . following through from the primary crushers to the casting machines.

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Volume 135 DECEMBER 1934 Number 12

Business and Government In Cooperation

IN THE past sixty days a marked change has come over the relations between business and Government that augurs well for recovery. In October we felt that the crossroads had been reached. Apprehension of business over the recovery and reform policies of the Government had reached its peak, and there were many expressions of dissatisfaction ranging all the way from sober expressions of lack of confidence to open and vigorous revolt. At that time we counselled constructive compromise and cooperation.

Subsequently the President made overtures, sought the friendly cooperation of business, and invited constructive counsel. If business was dissatisfied, what did it have to offer other than mere denunciation of the New Deal? The response was instant and gratifying. Faced with political realities, organized business made convincing gestures toward cooperation and decided to play ball. Without promising full accord with all the President's ideas, it determined to give whole-hearted support to those measures it deemed good, and just as vigorous opposition to those it felt were retarding recovery. At last the ground was prepared for cooperation, not only between business and Government but, more important, among the organized groups of business itself.

Of the problems now to be faced none is of greater import than the future of NRA. That there is general acceptance of the code system of governing business there can be no doubt. Questionnaires and surveys in great number have demonstrated this beyond question. The mechanism and the details alone remain to be determined. And on these questions the National Association of Manufacturers has offered a sensible proposal. First, it suggests a divorce of the trade practice and labor provisions of NRA. Second, temporary legislation for a period of one year after the expiration of NIRA next June in order to gain still further experience under voluntary code regulation before permanent legislation is enacted.

In recommending divorce of labor policies and fair trade practices in future legislation, the N.A.M. feels that hours, wages, and other labor conditions vary so greatly throughout the country that they cannot be treated uniformly by national legislation. Ultimately, after the emergency has passed, labor policies should be determined by the States. Until then, however, it is recommended that existing labor legislation in NIRA be extended for a year, with clarifying definitions of collective bargaining. Similarly it is proposed to enact for a temporary period a Fair Trade Practice Act permitting business groups voluntarily to adopt and make effective codes of fair competitive practices. This legislation would be administered by an independent court with authority to approve or disapprove the terms of a code.

Although not engaged in "manufacture," the mining industries in the fields served by this publication are vitally interested in the recovery of the industries that consume non-ferrous metals. They may well, therefore, join in the current movement to cooperate with the Government in the rehabilitation of manufacture and construction. In the future conduct of their own business, with or without voluntary codes, we believe that the mining industries should be reminded of the fact that they are dealing with natural resources in the exploitation of which the Government claims an interest on behalf of the public and conservation. This may imply a minimum amount of governmental supervision as the price that will have to be paid for the privilege of adopting artificial controls to stabilize these industries. Another year's test of NRA will be helpful in working out these relationships.

Federal Loans to Mining

ALTHOUGH the Reconstruction Finance Corporation is earnestly desirous of making direct loans "to recognized and established corporations, individuals, and partnerships engaged in the business of mining, milling, or smelting of ore," the actual disbursement of funds to the mining industry is moving slowly. Inquiry at RFC headquarters discloses the fact that although thousands of application blanks have been mailed on request, only about 100 applications for loans have been filed, and of these but three have been approved.

The results are disappointing, though probably not surprising, for mining is one of the most hazardous industries in which the Government could undertake to make loans. Nevertheless, we believe the mining industry can respond more intelligently and effectively than it has thus far. The only alternative conclusion is that there are not legitimate mining projects in need of money.

If you think you would like to obtain a loan from the RFC, the first requirement is to get and *read* Circular No. 14, from which we published in October the eligibility and security requirements. There is ample evidence that applicants have not read carefully either the circular or the application blank, and consequently have not followed carefully printed instructions. This has led to inevitable and unavoidable delay in acting on the application.

The application blank calls for information that any prudent investor in mining would be justified in demanding. The Government can do no less, for it expects the loan to be paid in five years. At first glance the blank may seem formidable, but if it is carefully read there will be little difficulty in understanding clearly what information must be furnished. Omission of essential facts will delay action until they can be obtained.

Apparently, one of the stumbling blocks in the application blank is the section on geology. The applicant may find it difficult to give all the information requested, but he should do his best and submit the application anyhow. He may not have the necessary data, but may be able to refer to U.S.G.S. maps and reports, which will be satisfactory. In any event, the geological information can be supplied later if the data on ore reserves, assays, and other technical matters are complete and convincing. The services of a competent mining engineer will be valuable in this respect.

In conclusion, we urge the mining industry to take the fullest advantage of this opportunity to finance worthy projects. At the same time we emphasize the necessity of approaching the Government in a businesslike manner and meeting its requirements for loans.

Air Conditioning Offers Mining New Life

MINING at great depth is becoming of increasing importance in various parts of the world where ore reserves in upper horizons are nearing exhaustion. This condition prevails in pronounced form on the Witwatersrand. In this district a vertical depth of about 8,400 ft. has been reached in the Turf shaft section of the Robinson Deep mine, and workings of numerous other properties in the area are being extended into what is termed the "deep-level" zone.

The difficulty on the Rand in economically hoisting ore up tertiary and secondary incline shafts and then up a primary vertical shaft led several years ago to the consideration of sinking a row of new vertical shafts that would cut the gold-bearing reefs at a much greater depth than the existing vertical shafts. At that time, however, the chairman of the committee investigating the practicability of mining the Main Reef Series at a depth of 10,000 ft. and beyond stated in his report ". . . but it would seem that the greatest difficulties are heat, ventilation, and humidity."

General recognition of the fact that the aforesaid factors were those controlling an extension of the depth of mining operations on the Rand has led in the last few years to an intensive study of available means for surmounting the difficulties that these factors present. As briefly described in the August issue of *Engineering and Mining Journal,* these efforts have resulted in the installation of the world's largest air-conditioning plant at the Robinson Deep mine.

Mining engineers throughout the world will watch this ambitious venture in air conditioning with much interest. A successful attack on "heat, ventilation, and humidity," coupled with the information that will probably be available soon in the field of rock dynamics or "barodynamics"—to use the word coined recently to connote this particular research effort—would appear, jointly, to offer to mining a real "new lease on life."

Blowing With Oxygenated Air

Gives Improved Results in Converting Copper Matte

S. Tonakanov
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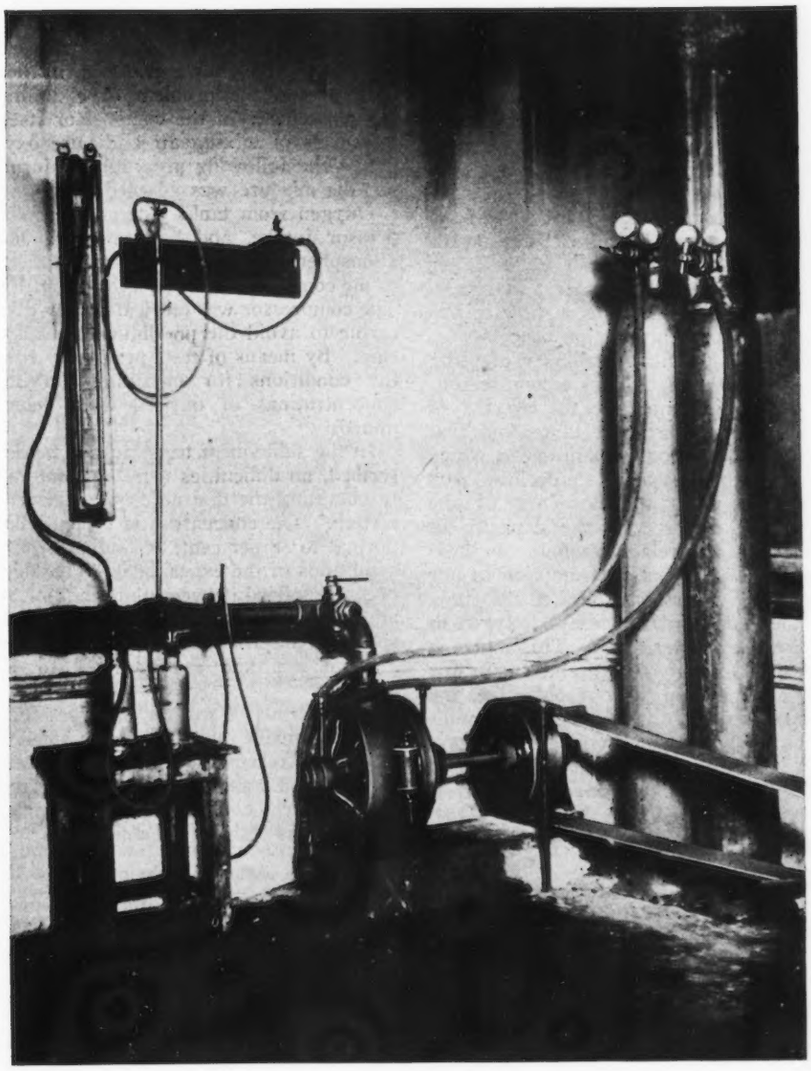
Moscow, U.S.S.R.



Research shows decisive advantages are possible on a commercial basis, without attendant difficulties — cheaper oxygen necessary to make the process practical

OXIDIZING PROCESSES have a conspicuous rôle in metallurgy. In many cases, upon applying a series of preliminary oxidation operations, the removal of impurities and the liberation of the metal are attained. This takes place in copper metallurgy, for example. The wide scope of metallurgical converting and refining also points strongly to oxidizing processes. The oxygen of the air is the agent which allows these processes to function. However, together with the active element, oxygen, the blast introduces into the metallurgical processes an inert gas, nitrogen, whose volume is 3.7 times larger than that of oxygen.

One may naturally suppose that with the increase of oxygen concentration in the air, a marked improvement in the action of metallurgical processes should result. This may be expressed in the increased capacity of the metallurgical units, the intensification of the processes, and an improvement in the thermal régime of the furnace, permitting the utilization of low-grade ores. This explains the interest which metallurgists have long shown in the problem of using oxygenated air. Cottrell, Edwards, Wright, Derclaye, and others[1] have studied the used of oxygen in this respect.

Prior to the War, tests were made in Belgium regarding the use of oxygen in blast-furnace smelting. In the United States, the work in this field was undertaken by Johnson. In 1923, the United States Bureau of Mines published a report of a committee which studied, in many cases experimentally, the effect of oxygenated air in blast-furnace smelting

[1] "The Use of Oxygen or Oxygenated Air in Metallurgical and Allied Processes," U. S. Bureau of Mines, 1923, pp. 3 and 4.

Fig. 1—Oxygenating the air, for use in the tests. Oxygen from the tanks (on the right) enters the intake of the compressor (in the center) and mixes with the atmospheric air in the latter's working chamber

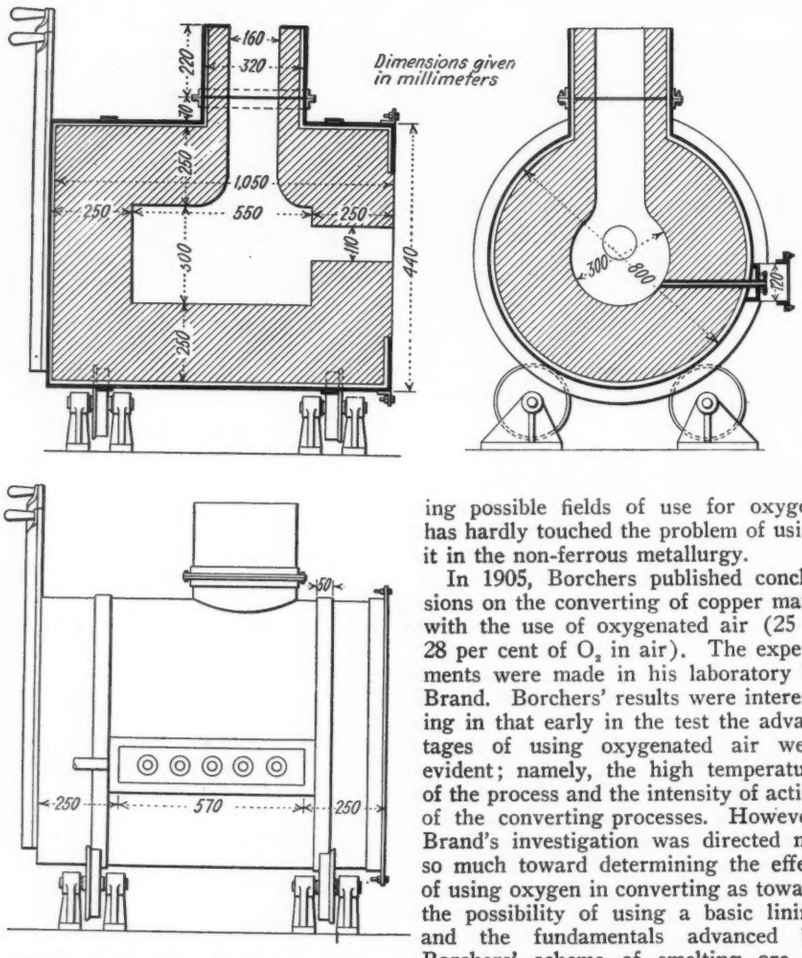


Fig. 2—The converter used was specially constructed for the tests. The drawing of it, here seen, shows an end section, a longitudinal section, and an exterior view looking toward the tuyeres

and on the open-hearth and bessemer processes, as well as in the production of steel and ferro-alloys. The committee, in its conclusions, points out the favorable effect of oxygenated air on blast-furnace capacity and coke consumption.

In the U.S.S.R., the Nitrogen Institute took the initiative at the Chernorechensky chemical works in 1932.[2] An experimental furnace was built to test the effect of an oxygenated blast in iron making. Lengthy experiments were performed and gave such promising results that the People's Commissariat of Heavy Industry arranged to change one blast furnace over to blowing with oxygen. Test runs were made in open-hearth furnaces at the Krassnoe Sormovo and Serp i Molot works.

Unfortunately, data on the use of oxygen blowing in the metallurgy of non-ferrous metals are very scanty. The Bureau of Mines committee, which gave special attention to the problem of finding possible fields of use for oxygen, has hardly touched the problem of using it in the non-ferrous metallurgy.

In 1905, Borchers published conclusions on the converting of copper matte with the use of oxygenated air (25 to 28 per cent of O_2 in air). The experiments were made in his laboratory by Brand. Borchers' results were interesting in that early in the test the advantages of using oxygenated air were evident; namely, the high temperature of the process and the intensity of action of the converting processes. However, Brand's investigation was directed not so much toward determining the effect of using oxygen in converting as toward the possibility of using a basic lining and the fundamentals advanced by Borchers' scheme of smelting ore to matte, blowing matte to high-grade matte, and the electrolysis of the latter to produce metallic copper. Borchers' article was written with a view to improving copper production processes[3].

A more practical possibility of using oxygen in the metallurgy of non-ferrous metals is presented by the process of converting matte; that is to say, that field of non-ferrous metallurgy in which the actual air blast plays a deciding part and determines the flowsheet of the technological process, the capacity of the plant, and related factors. Following this fundamental assumption in our investigation, we have limited the study of the problem to the use of oxygen in converting copper matte. This article is written to clarify that problem. In our work we set up, as our objective, the determination of the following conditions accompanying the use of an oxygen blast in converting copper matte:

1. The rate of the converting process, using oxygenated air.
2. The thermal conditions during the converting process.
3. The effect of oxygenated air on the formation of magnetites.
4. The influence of oxygenated air on the tendency of copper to enter the slag.
5. The effect of oxygenated air on the quality of the copper.
6. The influence of oxygenated air on the life of the converter lining.

Data as to the equipment used and the preparations for the experiments are given in the following paragraphs:

1. *The Converter*—A special converter was built, the drawing of which is shown in Fig. 2. Its basic dimensions in millimeters are: length (outside wall), 1,050 mm.; inside diameter, 300 mm.; outside diameter, 800 mm.; and the diameter of the mouth, 160 mm. The converter has five tuyeres of 15-mm. diameter each. For heating, it is equipped with oil burners set in the side wall. The lining consists of magnesite brick. The converter is turned by hand by means of a tripper welded to the shell within the side wall. Air is supplied from a compressor of 3 cu.mm. per minute capacity through a pipe 50 mm. in diameter. The general view of this compressor is shown in Fig. 1.

2. *Production of Oxygenated Air*—Contemporary technology has solved the respective problems of producing pure oxygen and that of producing air with an oxygen content of 45 to 80 per cent. This is accomplished in the widely known apparatus of Linde-Frankel, capable of furnishing 150 cu.mm. per minute of pure oxygen compressed to 1.5 atmospheres. We lacked such an oxygen plant, however, and turned therefore to the problem of obtaining oxygenated air in the compressor itself by means of mixing air and pure oxygen. The following procedure in forming the mixture was adopted:

Oxygen from tanks entered the compressor intake, and upon meeting the atmospheric air in the working chamber of the compressor, mixed well. (Fig. 1.) The compressor was lubricated with glycerine to avoid the possibility of explosion. By means of tests previously run, the conditions for obtaining varying concentrations of oxygen were determined.

In the subsequent tests, now to be described, no difficulties were encountered in obtaining the desired oxygen concentration.[4] The concentration varied from normal to 38 per cent, depending on the conditions of the experiment. The blast pressure varied between the limits of 50 and 300 mm. of mercury column. The speed of the air stream did not exceed 21 mm./sec. and averaged 12 to 18 mm./sec.

3. *Materials Used in Charge*—The tests were made on copper matte smelted from Krassnyuralski concentrates. Quartz sand was used for siliceous flux. The chemical composition of the materials used is shown in Table I.

[2]"Oxygen," The Committee on "Chemization" of Public Economy, Planning Commission, U.S.S.R., 1933.

[3]*Metallurgie*, 1904, I, p. 182.

[4]It was possible to effect a mixture by connecting the oxygen pipe directly into the air pipe, eliminating the compressor. This method, however, has the disadvantage that, due to the varying speeds and pressures of air stream and oxygen stream, respectively 1 atmosphere and 8 atmospheres, air currents inevitably result, precluding the possibility of effecting a good mixture of air and oxygen and thus maintaining a constant concentration of oxygen in the mixture. For this reason we refrained from using that method.

Table I—Composition of Materials Used

Materials	Chemical Composition			
	Cu	Fe	S	SiO_2
Matte I.....	23.98	48.48	26.39	.....
Matte II.....	50.40	25.15	23.60	.....
Quartz.....	.....	3.04	.....	95.78

Matte I was used for the first set of experiments. Matte II was used for the other experiments in which a rich matte was desired.

4. *Test Control*—Prandtl tubes were used to measure the speed of the air stream and the volume of air delivered to the converter. The derived data were checked also by another method: As we know, if a measured quantity of a gas is brought in contact with an unknown quantity, the total volume of the resulting gas can be computed if the composition of the mixture is known. Knowing the quantity of oxygen used from the tanks for one operation, by determining the oxygen content in the mixture we had an exact check on the data obtained by measuring the air consumption in the operation.

Determination of oxygen in the converter gases and in air was made by means of an alkaline solution of pyrogallic acid. The SO_2 determination was done by an iodometric method. A platinum-platinorhodium thermocouple measured the temperatures. In several tests, we succeeded in effecting a continuous temperature measurement throughout the entire converting period.

5. *Converting Practice*—Matte was charged into the converter heated to 1,100 deg. C. The burner was removed as soon as the matte melted; then quartz was added, the blast was turned on and the converter rotated to a working position.

Duration of the operation was established by preliminary calculations. The end point could be recognized in part by the color of the flame.

The history of copper matte converting shows that the small range of the converter apparatus and its consequent lack of heat was one of the serious causes of the difficulties that arose in the early change to basic converting.

At the beginning of our work we feared that owing to the small scale of operations and apparatus, the heat developed in converting would not be sufficient to make up for the loss of heat in exhaust gases, in radiation escaping through the converter surface, convection, and other ways. Therefore, to get practice with such small-scale converting operations, the first blows were made with the burner in action. After several trial operations we found that the bath needs no auxiliary heating, even when converting is carried out with normal air. Therefore, in the subsequent blow the burner was removed. (See Fig. 3.)

In commercial practice, in converting low-grade matte by using repeated charges of matte, a sufficient quantity of white metal is collected, which is consequently blown to blister copper in the same converter or transferred to a second one. In several tests, we limited ourselves to blowing to white metal.

Normal air as well as oxygenated air was used in the converting tests. A definite generalization can be made by comparing the results of operations obtained with the test converter, using the usual oxygen concentration with an increased oxygen content in air.

RESULTS OF USING OXYGENATED AIR

Up to a Maximum of 38 per cent O_2

IN CONVERTING COPPER MATTE

1. **Rate of converting is increased several fold**
2. **Process temperature is raised, thereby improving the thermal balance but without appreciably affecting the life of the lining**
3. **Tuyere punching is greatly decreased and the life of the tuyeres prolonged**
4. **Normal slags of high fluidity are obtained, the ferrite content remaining practically unchanged**
5. **Copper of normal grade is produced, without more than the usual amount of impurities, particularly oxygen**
6. **SO_2 content of gases tends to increase**

The Rate of Converting When Oxygenated Air Is Used

The object of converting copper matte by passing a strong blast of compressed air through the layer of molten matte is to oxidize and remove iron and sulphur and to obtain copper in a metallic state. The reaction of FeS oxidation determines the basic problem of removal of iron and sulphur by converting. It should therefore be promoted in every way. It can be accelerated by increasing the concentration of the reacting materials and by raising the temperature. Acceleration of the converting operation is attained by blowing the maximum quantity of air in a unit of time.

By increasing the oxygen content of the air we achieve the same purpose—namely, an increase in the quantity of FeS oxidized in a unit of time and at the same time intensifying the process.

With an increase in the oxygen concentration in air (consistent with calculations as shown in Table II), the amount of the latter required for converting an equal quantity of matte decreases (the duration of converting is respectively shortened) within the limits of Table II.

Table II—Amount of Air Required

Oxygen in Air	Required Amount of Air, %	Remarks
21	100	
27	77.50	
30	70.0	Maximum
33	64.0	oxygenation of
35	60.5	air in our
38	55.0	tests was 38%

Thus, by means of calculation, we can predict that when the oxygen content is raised from 21 to 38 per cent we should expect a decrease in the time required for converting to one-half, provided the total volume of air used be lowered by 45 per cent. The converting intensity, however, will be controlled not only by an increase in the oxygen content of the air but also by an increased temperature in the converter. The combined action of these two factors gives a picture of the actual intensification of the converting process. This should be checked by experimental data.

Results obtained in the converting tests coincide satisfactorily with computed data, as is shown by the curves in Fig. 5. These curves illustrate how the air consumption in converting an equal quantity of matte (30 kg.) falls, depending on its degree of oxygenation. Table III gives more details.

The curves representing the duration of converting (Fig. 4) show a great saving in the time of converting while using air enriched with oxygen up to 38 per cent. The time saved in the first converting period is 3.7 times for low-grade mattes and three times for high-grade mattes. Thus the experimental check proved that by using oxygenated air the rate of the converting process for copper matte is increased many times.

Table III—Data on Converting Copper Matte

Converting of Matte I—25% Cu				Converting of Matte II—50% Cu			
Test Conditions, % of O_2 in Air	Air Consumed in Cubic Meters at 0°, 760 Mm. 30 Kg. Converted	% Cu in Matte Obtained	Duration of First Period in Minutes	Test Conditions, % of O_2 in Air	Air Consumed in Cubic Meters at 0°, 760Mm. 30 Kg. Converted	% Cu in Matte Obtained	Duration of First Period, in Minutes
(Normal) 21	56.6	71.88	30	21	34.2	76.50	18
27	34.6	71.08	20	..	....	.....	..
30	27.3	78.07	17	35	21.5	79.42	10
38	21.2	74.37	8	38	14.6	79.53	6

Table IV—Converter Temperatures

Test Conditions: Copper Content of Matte Used in%	% of O_2 in Air	Temperature in the First Converting Period: Degrees Centigrade — Prior to Blowing	Minutes of Converting Period: 1st	2d	3d	4th	5th	6th	7th	8th	9th	10th	11th	12th	13th	14th	15th	17th	20th	25th	30th	Before Blowing	Second Converting Period After Blowing
25	21.0	1,132	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1,154	....	.....	.....
25	27.0	1,225	.....	.....	1,290	1,350	1,375	.....	1,400	.....	1,390	.....	1,390	1,400	1,420	1,415	.....	.....	.....	.....	.....	.....	.....
25	30.0	1,215	.....	.....	1,335	.....	1,350	.....	.....	1,295	.....	.....	1,320	.....	.....	1,355	1,350	.....	.....	.....	.....	.....	.....
25	30.0	1,180	1,220	1,230	1,240	.....	1,195	.....	1,210	1,220	1,220	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
25	38.3	1,265	1,390	.....	1,470	1,490	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
50	21.0	1,215	.....	1,215	.....	.....	1,245	.....	1,255	1,255	.....	1,255	1,245	.....	.. ..	.....	.....	1,200	1,200	1,190	.....	.....	1,225
50	21.0	.....	.....	1,125	.....	1,135	.....	1,140	1,140	1,150	1,175	1,200	.....	1,205	1,210	.....	1,200	1,200	1,190	.....	....	1,275	1,225
50	27.0	1,240	.....	.....	.....	1,275	.....	1,300	1,270	.....	.....	1,260	1,260	1,260	1,280	1,290	.....	.....	.....	.....	.....	.....	.....
50	30.0	1,200	.....	1,255	1,295	1,335	1,370	.....	1,400	1,425	1,435	1,425	1,395	.....	.....	.....	.....	.....	.....	.....	.....	1,245	1,335
50	35.0	1,195	.....	1,230	1,275	1,320	1,345	.....	1,345	.....	1,360	1,350	.....	.....	.....	.....	.....	.....	.....	.....	....	1,235	1,240
50	38.0	1,170	.....	1,245	1,295	1,325	1,325	1,290	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	....	.....	.....

In converting copper matte, the temperature in the converter is usually 1,150 to 1,250 deg. C. The general belief is that to prolong the life of the lining, the temperature should not exceed 1,250 deg. C. The process temperature must rise when oxygenated air is used. Many metallurgists consider this fact as a basic argument against using oxygen in metallurgical processes, considering the high temperature as a threat to the length of life of the refractory brickwork. In view of these objections we find it necessary to give a detailed explanation of the results arrived at in our tests relative to the actual conditions in the thermal régime of converting. A complete answer to the question is afforded by the experimental data tabulated in Table IV.

As the result of experimental checking, we may say that the use of oxygenated air in converting copper matte gives a higher process temperature than when normal air is used. The converter temperature rises from 50 to 230 deg. towards the end of the first converting period when oxygenated air is used, whereas under conditions of normal oxygen content in air hardly any noticeable temperature rise occurs. This range of temperature rise depends on the oxygen content in air, the grade of matte (within the 25 and 50 per cent limits), and the degree of preheating.

The maximum reached was 1,490 deg. C., when 38 per cent oxygen was used, the temperature ranging between 1,250 and 1,350 deg. Consequently, assumptions that exceptionally high temperatures are developed in converting copper matte with the use of oxygenated air have no basis. The increase of temperature to 1,500 deg. C., while affecting but little the life of the lining, improves the thermal balance, permitting the addition of cold materials in appreciable quantities.

The heat developed in converting as the result of using oxygenated air keeps the tuyeres in good condition, rendering frequent punching unnecessary. This is in contrast to the fact that under conditions of blowing with normal air, continuous punching is inevitable. In operating our test converter we punched the tuyeres only once during the entire first period. Some operations required none at all.

Converter slags are strongly basic iron slags. They contain 1.5 to 4 per cent copper, 18 to 29 per cent silica, and 50 to 70 per cent FeO. Professor Silivanoff proved the existence of a compound—a monosilicate of ferrous oxide—in his research of the system $FeO\text{-}SiO_2$[5]. Its composition was FeO, 70.6 per cent; SiO_2, 29.4 per cent, and the fusion point was 1,260 deg. C.

The monosilicate of ferrous oxide with FeO gives an eutectic, the fusion point of which is 1,230 deg. C., while containing 26 to 27 per cent of SiO_2. Professor Silivanoff stresses the statement that, together with the formation of these unions in the $FeO\text{-}SiO_2$ system, higher oxides of iron, such as Fe_2O_3 or Fe_3O_4, are present.

With insufficient SiO_2, the iron oxide formed in the bath reoxidizes to higher oxides, giving compounds of the type $(FeO)x\ (Fe_2O_3)y$ or occasionally magnetite, Fe_3O_4.

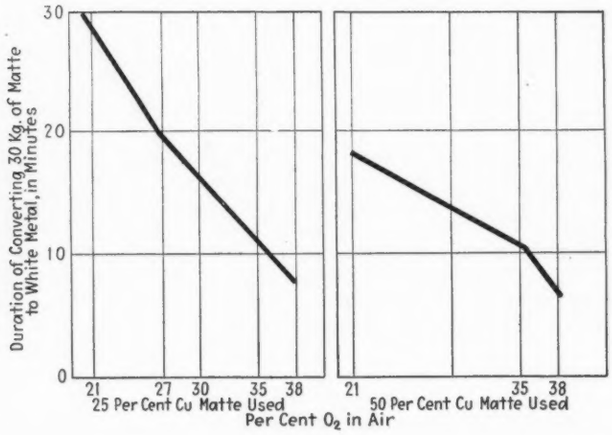
Formation of ferrite is the principal feature of basic converting. The ferrite increases the specific gravity of the slag as well as its viscosity and refractoriness, which results in an increased loss of copper in the slag. Ferrite formation is an undesirable phenomenon in converting practice.

At the "VNITO" conference on oxygen, fears were entertained that the high partial pressure of oxygen in the working mixture of air may cause an

[5]Professor Silivanoff: "System FeO-SiO_2." *Metallurg* No. 1-2, 1928.

Fig. 3—(Left.) Here the converter is shown in its working position during the first period

Fig. 4—(Below.) These curves show the change in duration of converting with the increase in concentration of O_2 in the air



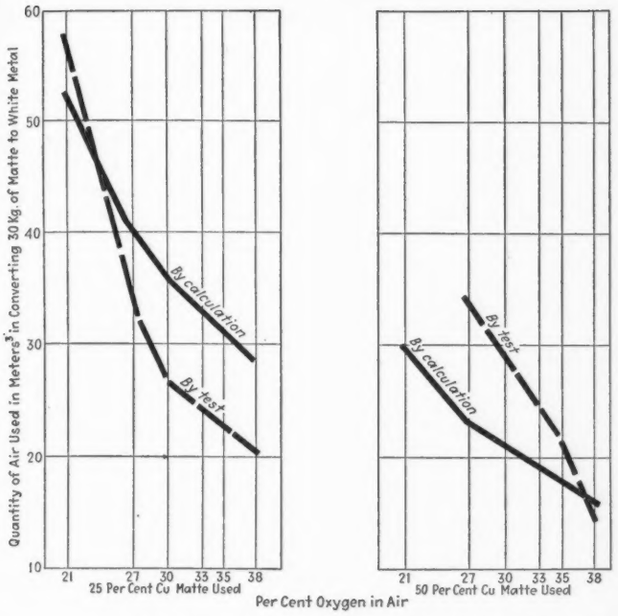


Fig. 5—(Above.) How the amount of air consumed in converting matte decreases as its oxygen content increases is demonstrated by these graphs

Fig. 6—(Right.) This was the position of the converter during heating

oxidation of FeO to higher iron oxides. C. A. Palkovsky, metallurgical engineer, believes that "the high partial pressure of oxygen unquestionably will influence the formation of higher oxides."[6]

To investigate this point, the converter slags were submitted to partial analysis for ferrous oxide. The essence of Hildebrandt's method of determining the presence of ferrous oxide in slag is as follows: The siliceous ferrous oxides are decomposed upon heating with sulphuric and hydrofluoric acids in a current of CO_2, so that all the iron passes into solution as $FeSO_4$. Ferric oxide also is decomposed in H_2SO_4, forming $Fe_2(SO_4)_3$. Ferrous oxide is directly titrated with $KMnO_4$ solution. After decomposing the silicates, an excess of hydrofluoric acid exists which must be removed by an addition of a silica gel or boric acid, because in some cases stable fluo-ferric compounds may be formed. The ferric oxide is determined by calculation by difference. Results of the partial analyses are given in detail in Table V, presented below.

[6]"Oxygen." P. 194.

On the basis of the accompanying tabulated data, the following conclusions can be made:

1. The proportion of ferrous and ferric oxides remains almost unchanged when oxygenated air is used in converting low-grade matte. This relation fluctuates between 1.4 and 1.6 when air of normal oxygen content is used, and between 1.4 and 1.5 when the air is oxygenated.

2. When high-grade matte is converted, an analogous regularity exists in the ferrous and ferric oxide relations. The Fe″/Fe‴ relation fluctuates between 5.0 and 6.6 with normal air and between 4.0 and 6.0 when the air is oxygenated.

As should be expected, a greater formation of ferrite takes place when blowing low-grade matte, as witnessed by the large percentage of higher iron oxides.

Comparison of our data with the conclusions given in literature is interesting: The data of Professor Mostovich on the Fe″/Fe‴ relation in the converter slags at the Rio Tinto plant is expressed[7] as $49.5 \div 11.2 = 4.4$.

In the paper of Professor Silivanoff[8], referred to previously, the relation of $\frac{FeO}{Fe_2O_3}$ in the monosilicate group fluctuates between 4.6 and 7.6. We can conclude that our test results conform to the statements of these authors.

Thus we may accept as a fact that the ferrite content of the slag shows no noticeable change when oxygenated air is used. Normal slags of high fluidity are obtained.

An increase of silica can be noticed in the converter slag, ranging between 30 and 36 per cent, as compared to the usual 22 to 30 per cent. This increase is not the result of using oxygenated air, inasmuch as the phenomenon also occurs to the same degree in tests run with normal air. We explain it by the fact that under our particular test conditions we used an excess of quartz, in a small bath.

The copper content of the converter slags obtained ranged from 1.7 to 7.5 per cent (usually 2.5 to 3 per cent). The copper content was equally high, whether normal or oxygenated air was used, and was caused solely by the settling conditions of the bath. This can be illustrated by comparing the data on percentage of copper in converter slags when similar settling conditions prevailed. (See Table VI.)

Table V—Composition of Converter Slags

Test Conditions: % Copper Content in Matte	Test Conditions: % Oxygen Content in Air	Slag Composition: Cu	Slag Composition: SiO_2	Slag Composition: Fe	Fe″ and Fe‴ as Part of Fe Column		Relation Fe″/Fe‴
25	21	1.73	33.76	46.6	28.6	18.0	1.6
25	21	3.86	33.48	42.0	24.3	17.7	1.4
25	21	1.63	31.86	46.9	28.2	18.7	1.5
25	27	1.99	30.66	49.0	29.9	19.1	1.5
25	30	5.26	36.17	40.7	23.9	16.8	1.4
25	30	1.53	34.47	42.8	26.0	16.8	1.5
50	21	4.09	33.19	41.0	34.1	6.9	5.0
50	21	2.61	35.50	40.5	35.2	5.3	6.6
50	33	7.48	32.74	40.0	32.0	8.0	4.0
50	35	7.48	32.39	38.8	31.2	7.6	4.1
50	38	4.09	33.19	41.0	35.2	5.8	6.0

[7]V. I. Mostovich: "Metallurgy of Copper." P. 321.

[8]Professor Silivanoff: "The System FeO-SiO_2." *Metallurg*, No. 1-2, 1928.

Table VI—Copper Content of Converter Slags

Test Conditions: Copper, % in Matte	Test Conditions: % Oxygen in Air	Copper, % in Converter Slag
25	21	1.73
25	27	1.63
50	21	2.61
50	38	4.09

In all cases where the method of slag removal for tests was identical, the copper content of converter slags showed no change.

In considering the problems of using oxygenated air in converting copper matte, the possibility of lowering the grade of the copper, particularly by increasing its oxygen content (Cu_2O), presented itself. Consequently we included the study of the question of the grade of the copper in our investigation.

The chemical composition of blister copper is given in Table VII.

Table VII—Composition of Blister Copper

Test Conditions: % O_2 in Air	Chemical Composition of Copper: Cu	Fe	S
21	97.26	1.3	0.88
27	98.92	0.09	0.76
30	97.30	....	....
21	98.04	....	....
30	98.44	0.063	....
21	.....	0.032	....
21	98.88	0.024	....
38	98.76	0.016	....

The Natré (Hampe) method was used in determining the presence of oxygen in metallic copper. This method reduces the copper oxide in the copper to metal by using a stream of pure hydrogen. The water formed by this reaction, according to the equation $Cu_2O + H_2 = H_2O + 2\ Cu$, is taken up by means of phosphorus anhydride placed in a weighed U-tube. The weight increase was calculated for O_2. Results of analysis are shown in Table VIII.

Table VIII—Oxygen Content in Metallic Copper

% Oxygen Content in Air	% Content of O_2 in Metallic Cu.	% Cu Content in Matte
21.0	0.39	25
27.0	0.37	25
30.0	0.38	25
30.0	0.61	50
21.0	0.59	50
21.0	0.38	50
38.0	0.41	50

On the basis of the data in Table VIII we may conclude that in converting copper matte by oxygenated air the copper produced is of normal grade, without impurities, particularly oxygen, beyond the usual amount.

Life of the Converter Lining

Evidently the question of the life of magnesite lining can be effectively solved only in large-scale operations, inasmuch as the only criterion is the behavior of the lining over an extended period of use. In our case we were able to observe the lining only under the test conditions, so that our conclusions are but conditional. The test converter was run over a period of eleven months. At the end of each run we noted the condition of the magnesite lining. During the entire period it remained in good condition, despite the discontinuous nature of the work. The latter circumstance implies marked variations of temperature, which condition is ruinous for the lining.

Relining was done at the tuyere level only once during the entire period in which the converter was used. In general, this area was found to be the most vulnerable spot in the lining. The cracks in the lining were filled with Sorel cement[9].

Observations as to the behavior of the lining may be summed up by saying that it did not show noticeable deterioration from using oxygenated air.

Others who have investigated the life of refractory lining arrive at the same conclusion. Professor Chekin[10] states that in tests using oxygenated air the lining of the Chernorechensky blast furnace was not damaged, but stood up rigidly. Professor Pilnik[11] says that "oxygen addition has not noticeably affected the strength of the refractory brick in the working areas."

Behavior of the metallic parts of the tuyeres was also noted. Only the ends of the tuyeres, for a distance of 70 to 80 mm. where they were submerged in the bath, gave evidence of being burned through. The entire remaining length did not corrode, irrespective of the use of oxygenated air. This burning of the ends occurred because during the period of heating the converter (12 to 15 hr.) and melting the matte, the tuyeres were subjected to the corrosive action of the heat and gradually corroded.

In general, we conclude that the tuyeres were not damaged much, despite the increase in the oxygen content of the air. They had to be replaced as often when using normal air.

On SO_2 Concentration in Gases

Theoretically, according to the calculations for converting with the use of oxygenated air, the SO_2 concentration should increase from 10 to 12 per cent to 20 to 25 per cent, due to the decrease in the volume of waste gases. We found, however, that it was practically impossible to obtain such a high percentage of SO_2 in gases as indicated. This is explained by the very great dilution of converter gases by atmospheric air, resulting from the fact that the mouth is not flush with the gas flue. The dilution was so large in our tests that the actual picture of gas composition is distorted. We attempted to take a sample of gases for analysis through the firebrick opening in the side above the bath, but this is not sufficiently precise, for it cannot give an exact knowledge of the composition of the gases to be obtained in practice.

Table IX gives comparative data on the composition of converter gases obtained when blowing with normal air and with oxygenated air respectively. The figures show a definite tendency toward an increase in the SO_2 content in gases when oxygenated air is used. However, these data cannot be considered as a basis for appraising the quality of gases, and they therefore should be taken as conditional only.

Conclusions

The investigation showed that no difficulties whatsoever were created by using oxygen in converting copper matte. On the other hand, the use of oxygenated air has decisive advantages, as explained. It follows that this method can be used on a production scale. The practical solution to the question, however, lies in the problem of obtaining cheap oxygen. In the research[12] made by the committee of the United States Bureau of Mines, previously referred to, the committee concluded that "at the present time it is possible to produce cheap oxygen" for use in metallurgical processes.

The investigation here described was conducted under my supervision in the pyrometallurgical laboratory of the Institute of Non-Ferrous Metals at Moscow, Russia.

Table IX—Comparative Data, Converter Gas Composition

Test Conditions: Oxygen Content in Air, %	Copper Content in Matte, %	Converting Period	% SO_2 Content in Gases: 5 Min. After Start of Converting	10 Min. After Start of Converting	15 Min. After Start of Converting	20 Min. After Start of Converting	25 Min. After Start of Converting	% Oxygen Content in Gases: 5 Min. After Start of Converting	10 Min. After Start of Converting	15 Min. After Start of Converting	20 Min. After Start of Converting
21	25	I	1.74	2.88	....	3.29	4.30	Not determined			
11	25	II	3.54	....	....	....	....	....	....	....	....
11	25	I	4.19	2.60	3.21	3.29	3.82	Not determined			
11	25	I	2.10	3.90	3.90	1.40	1.40	....	....	....	....
27	25	I	....	4.31	....	8.79	....	....	....	....	....
27	25	I	3.50	5.20	5.95	....	....	....	....	....	....
30	25	I	6.15	6.14	....	....	....	....	....	....	....
30	25	I	6.14	11.52	....	....	....	....	....	....	....
30	25	I	8.00	....	....	....	....	8.00	8.00	....	....
21	50	I	5.10	4.00	....	....	....	....	....	....	....
21	50	I	3.00	6.00	6.00	5.10	....	12.50	....	....	10.8
27	50	I	7.80	....	....	....	....	....	....	....	....
27	50	I	6.90	5.14	1.40	....	....	....	....	....	....
30	50	I	8.20	6.00	....	....	....	....	....	....	....
35	50	I	8.20	....	....	....	....	8.0	....	....	....
35	50	II	9.0	....	....	....	....	....	....	....	....
38	50	I	3.0	6.00	6.00	5.10	....	12.5	....	....	10.8

[9] Sheliagin, V. V.: "Caustic Magnesite," "Mineral Raw Materials No. 9," 1929

[10] "Oxygen." P. 63.

[11] "Oxygen." P. 144.

[12] "The Use of Oxygen or Oxygenated Air in Metallurgical and Allied Processes." 1923. P. 4.

Deductions for Depreciation May Be Cut

If Mining Executives Ignore the Treasury's Latest Move To Get More Income-Tax Revenue

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ANOTHER TAXABLE YEAR for Federal income-tax purposes is drawing toward its close. Five million individuals and four hundred thousand corporations, in round numbers, will be required to file returns under the 1934 Revenue Act. In making up these returns taxpayers with taxable incomes, because of the high rates of tax involved, the novel technical administrative provisions of the law imposing new and difficult requirements, and the necessity of conserving profits under existing conditions, and uncertainty as to what lies ahead, will give more serious consideration than ever before to the numerous factors that may enter into the determination of their statutory or taxable net income. That is, they will do this unless they are indifferent as to the amount of their tax bills, and, because of indifference or lack of foresight and preparation, fail to take into account all of the factors and methods provided in and under the income-tax statute, regulations, rulings, and decisions affecting the computation of true taxable net income.

Now is the time to begin to think about the matter of income-tax liability; and this is true regardless of whether or not accounting systems and methods have been previously worked out and established as the taxpayer's current accounting practice. New provisions of the income-tax law, new administrative regulations and rulings, and new decisions of the Board of Tax Appeals and the courts have made many important, and in some instances drastic, changes affecting the determination of tax liability. New administrative policies have been adopted. Changes have been made in administrative procedure. New officials with new viewpoints direct the administration of the taxing statute. All taxpayers whose incomes are or may be consequential will therefore do well to become forthwith adequately informed or advised on all phases of the tax law which may affect the amount of their tax liability. It is highly important to know the law; but it is equally important to know how the law is being or will be interpreted and applied.

In many cases, both individual and corporate, these are but a few of the many important items that must be considered: gain or loss from sales of securities and other capital assets and from exchanges of securities in corporate reorganizations and other transactions; the percentages of the gain or loss recognized in computing net income; the limitation on capital losses; income from interest, dividends, royalties, and trusts; deductions for losses, bad debts, improvements, repairs, depletion, and depreciation. Items of gross income must be properly computed and classified, and items of deductions must be anticipated and properly determined and substantiated, if the taxpayer wishes to be assured of avoiding the erroneous payment to the government of an amount in excess of the amount lawfully due and payable.

An Important Deduction

This discussion will be confined to the subject of depreciation, inasmuch as that item constitutes an important allowable deduction in practically all returns of any consequence from an income-tax standpoint, particularly in the returns of unincorporated business enterprises and corporations, such as those engaged in mining, oil production and quarrying, and manufacturing. The Treasury Department has promulgated a ruling which changes materially the administrative policy, and, incidentally, the practice of the department with respect to depreciation deductions. The ruling applies not merely as to the future, but retroactively to cases arising under prior revenue acts where such cases are still open. It amends Articles 205 of Regulations 77 and 74 and Articles 165 of Regulations 69, 65, and 62. These articles of former regulations, now amended, provided that

". . . While the burden of proof must rest upon the taxpayer to sustain the deduction taken by him, such deductions will not be disallowed unless shown by clear and convincing evidence to be unreasonable . . ."

The new regulation provides in part that

". . . The burden of proof will rest upon the taxpayer, to sustain the deduction claimed. Therefore, taxpayers must furnish full and complete information with respect to the cost or other basis of the assets in respect of which depreciation is claimed, their age, condition and remaining useful life, the portion of their cost or other basis which has been recovered through depreciation allowances for prior taxable years, and such other information as the Commissioner may require in substantiation of the deduction claimed."

It provides also that

". . . The deduction for depreciation in respect of any depreciable property for any taxable year shall be limited to such ratable amount as may reasonably be considered necessary to recover during the remaining useful life of the property the unrecovered cost or other basis. . ."

The reader will note that under both the former and the new regulations the burden of proof "must" or "will" rest upon the taxpayer to sustain the deduction claimed, but that under the former, evidence submitted by the taxpayer could not be arbitrarily ignored or rejected, whereas under the new regulation, it may in the first instance always be a matter of official opinion and departmental policy whether any evidence submitted by the taxpayer is sufficient to sustain the deduction

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Now is the time to think about income-tax liability unless one does not mind paying more than is lawfully due . . . A new ruling makes material changes in administrative policy and departmental practice . . . This is also retroactive in cases as yet not closed . . . The official viewpoint has altered . . . Preparedness advisable.

claimed by him. Of course, in any case where evidence which would be acceptable in a court of law is rejected by the administrative authority, the taxpayer has recourse to the Board of Tax Appeals and the courts.

This new regulation was formulated and adopted under circumstances and conditions which did not augur results that would in any sense be favorable to the taxpayers. The ruling was made for the purpose of "limiting or restricting the amount of deductions that may be allowed for depreciation" and to "increase the revenue substantially," according to a letter from the Secretary of the Treasury to the chairman of the Committee on Ways and Means of the House of Representatives. The Ways and Means Committee had before it at the time a proposed amendment to the law which would have reduced all depreciation deductions 25 per cent, and would have limited the deduction to be taken on the return to 75 per cent of the "reasonable" amount otherwise lawfully allowable. The committee expected to raise $85,000,000 additional taxes annually by this amendment. The Secretary of the Treasury wrote, with reference to this, that "records indicate that the amount of the increase in revenue will equal that which would result from the proposal of the Ways and Means Committee." Thereupon, the committee proposal was abandoned in favor of the Treasury plan.

On the basis of this record, those familiar with the matter do not regard it as unduly critical to assume that the desire for *increased revenue, rather than a wish to provide improved methods for determining the correct amount of depreciation,* was the underlying motive which impelled the Treasury to adopt this regulation. Certainly, good reason exists for believing that the committee abandoned its proposal because of representations made to its members that the Treasury plan woud achieve the purpose sought: the raising of additional revenue.

A Fundamental Ignored

Fundamentally, the function of administration should be to determine the right answer in each and every case, regardless of the effect upon tax liability. The mandate of the law is that the taxpayer shall be granted "a reasonable allowance." Interpreted, that must mean an allowance which, plus the salvage value of the assets, will at the end of the useful life of the property in the business equal the cost or other basis of the property. In judging the reasonableness of depreciation deductions under prior laws and regulations, the department has always in the past recognized that the determination of the useful life of assets and the consequent rates of depreciation is largely within the taxpayer's experience. How is it possible for the department to accomplish a material reduction of depreciation allowances without disregarding the taxpayer's experience?

In determining the basis for depreciation in prior years, the department has required taxpayers to furnish voluminous exhibits and schedules based upon their records and their experience. Assuming what would seem to be obvious, that the taxpayer, unless just starting in business, has already furnished the department all the information and data in his possession or available to him, as required by the former regulations, then it would appear that the new regulation, the new instructions to administrative and field officers and agents, and the new printed forms are merely the mechanism of a plan to raise additional revenue and not for the purpose of determining what is a "reasonable" allowance. Whether or not a multiplicity of appeals and suits will result unquestionably will depend upon the common sense and fairness of department officials, and, possibly, upon the ability of these officials to compromise and settle without appeal and trial most of the cases on a basis that will give the government more taxes. We do not believe that the courts will sanction material reductions in depreciation deductions that have been determined to be reasonable in the past. Especially will the courts look askance upon new determinations where their primary objective is to secure additional taxes. Unquestionably, therefore, opportunity and incentive for arbitrary administrative action exist. This is patent from the history of the new regulation.

Preparation May Lessen Tax

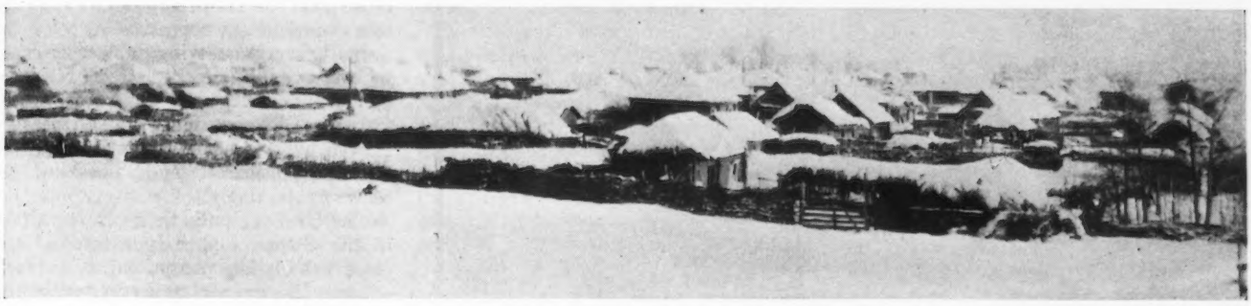
However, whether or not the new regulation is arbitrarily applied to reduce depreciation deductions may depend on the nature of the taxpayer's business, and, perhaps largely, on the extent to which taxpayers are equipped to furnish the information in the form now required to sustain these deductions. If a taxpayer is equipped with appropriate information for strict compliance with the new requirements, his situation conceivably may be better than before. He may be helped instead of penalized if good faith and fair judgment prevail. Item rates, for example, may in many instances produce higher aggregate deductions than composite rates, provided the taxpayer has been using composite rates; that is, rates covering units or groups of property rather than rates for specific items. Many rates of depreciation, covering as many different types of assets, have been sustained by the Board of Tax Appeals and the courts. Equipped with proper information and Board or court authority for deductions claimed, a taxpayer should be in a practically impregnable position to withstand any administrative attempt to cut his deductions down. Thus, a taxpayer who is adequately forewarned and forearmed may save himself a considerable amount in taxes, through sustaining his depreciation claims.

Supporting Data Must Be Submitted Anew

Although the information required under the new regulation is substantially the same as that required under the previous regulations, it is essential that all schedules and other data now deemed necessary shall be prepared and submitted anew by the taxpayer, when called for by the examining officer or other representative of the Commissioner. Many companies are already engaged in breaking down their depreciation accounts and reconstructing them in order to be prepared to substantiate adequately, in the manner now required, their depreciation deductions in returns for prior years still open as well as to sustain the deductions to be made in their 1934 returns. This unquestionably is the safest policy and the best course to pursue at this time.

In instructions to collectors, agents, and other employees of the Bureau, the Commissioner states that the schedules need not be furnished by the taxpayer for any year where (1) it is apparent that the deduction claimed is a very minor factor in determining net income, or (2) where the facts indicate conclusively that the deduction claimed in the return is not in excess of the correct amount, or (3) where it is clearly evident that no taxable income will be developed by disallowance or adjustment of the deduction claimed. The Commissioner, in a recent press release, assured taxpayers that in these three cases the new schedules will not be demanded. It must be remembered, however, that the exceptions enumerated cover only cases or years where there is no possibility of the government gaining additional revenue, either because the deduction claimed is of no material consequence, or because the supporting evidence precludes dispute.

In the case of mines and oil and gas wells, certain restrictions are involved in the classification of assets as between the depletion and depreciation accounts. Possible further restrictions are now in the process of being formulated, presumably in pursuance of the department's policy, heretofore referred to, of "limiting or restricting the amount of deductions that may be allowed for depreciation" and to "increase the revenue substantially." These restrictions involve technical questions which cannot be exhaustively treated in this brief article. For the present, taxpayers in the mining and oil industries will find it to their advantage from a tax standpoint to be prepared to submit their depreciation schedules as nearly as possible in accordance with the approved form issued by and obtainable from the department.



Any one of a hundred mining towns of the earlier days in Russia and typical of those of the changed regime

Russian Copper

- Ural reserves, which are now supplying three-quarters of the Soviet Union's current output, contain only one-fourth of the country's total estimated tonnage of the metal
- As they become depleted, production must come from much more distant points: Kazakstan and Central Asia, Siberia, Transcaucasus, and the Kola Peninsula

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MARKED CONFLICT in the many current opinions regarding Soviet Russia's mineral resources, and that country's potentiality as a metal producer and a competitor, has influenced the authors to prepare this article dealing with the U.S.S.R. copper reserves and certain trends respecting them. The data given have been taken substantially without change from Russian sources. A thorough combing of contemporary Russian technical journals, made in the light of a field experience covering all the major mineral areas of the country and extending over several years, has made possible a certain amount of discrimination in selection. Personal observation has naturally prompted occasional passing comment.

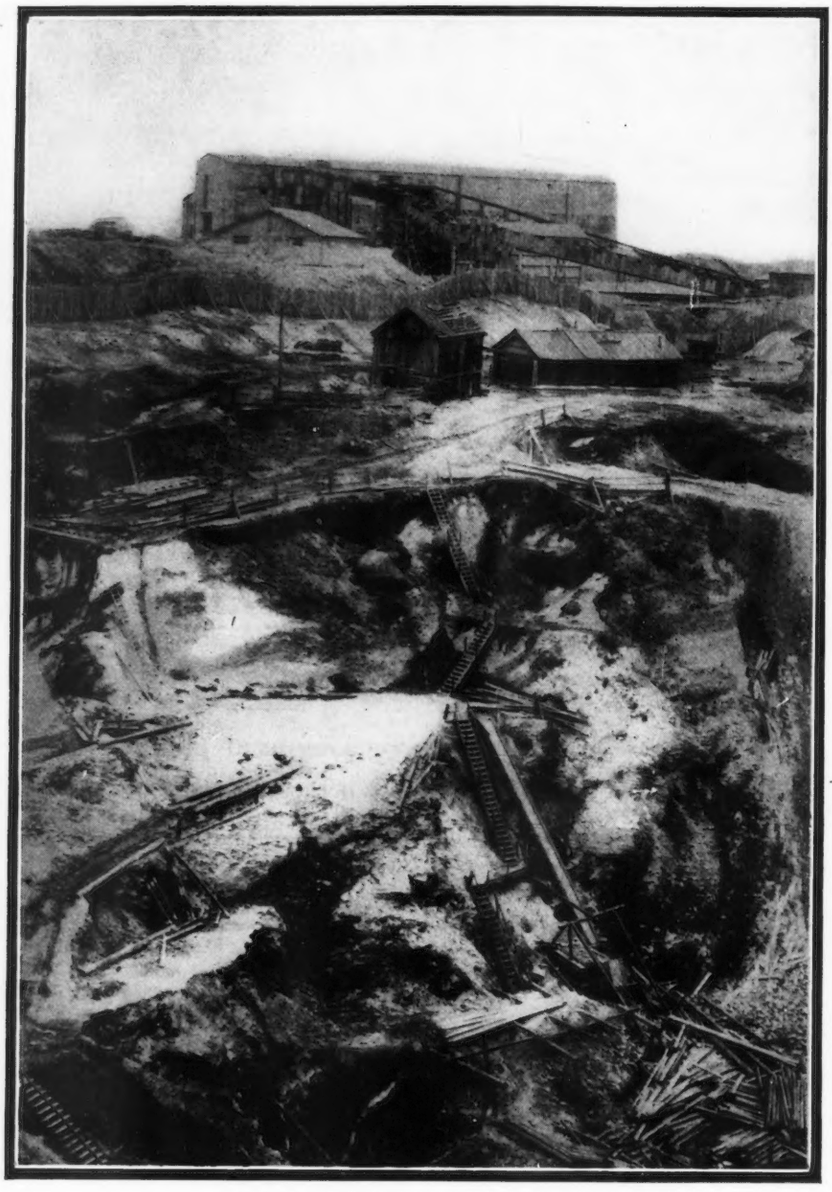
Those Russian geologists who are responsible for the estimates of Soviet copper reserves are in many cases recent graduates of a school system which was compelled to turn out a great number of engineers in a short time to meet the heavy demands of the "Piatiletkas" (Five Year Plans). In some instances, also, the geologists, in their estimates of the reserve in "possible" and "probable" categories, have perhaps been influenced by the generally optimistic attitude of the Soviet régime and by the official conviction that copper reserves can and must show a yearly increase. Certainly, the mineral endowment of the Soviet Union is huge, and its copper assets are yet far from being accurately determined.

That the copper industry, of all the major basic activities of Soviet Russia, is perhaps the least advanced will undoubtedly become apparent to the reader, without specific comment from ourselves. Viewing things broadly, moreover, the reader will perceive that nothing is to be gained from disputing details of the Soviet figures for this particular industry, in view of the fact that its competitive status can be rather definitely fixed for years to come by even the approximations as to ore grades, tonnages, and conditions of transportation.

Estimates of tonnage of copper reserves have mounted steadily in recent years despite the fact that the Soviet's geological department has been hampered in its deep-hole prospecting by the decision of the government to abandon diamond drilling in favor of shot drilling except in extraordinary cases, most of which are confined to gold operations. Reported reserves of copper represented by ore blocked out on four sides have shown a large increase annually, although statistics on mine development work and copper output show a slight annual decrease in the last two years.

In considering the grades of copper ores that we shall mention, one must not infer that all Russian copper deposits are low in grade. The fact is that the Soviets insist, in a 1934 ruling, that ore as low as 0.7 per cent in copper must be mined, although its extraction sometimes represents definite fiscal loss at the property where it is taken out, and, what is of even greater importance to the Soviets, a slowing up of copper production in general.

Interpretation of the cost of producing copper in the Soviet Union is virtually impossible in terms of American or African reckoning. As no permission to publish the exact figures in hand for recent years has been requested or obtained, we must confine our observations in this respect to the most general terms. We can point out, however, that, even when confronted with exact statement of costs in roubles, the only medium of Soviet accounting, the foreign accountant, no



The flotation plant at Kalata and the Oblavenski open pit

matter how expert, is well-nigh helpless in determining the real production cost in world values, for the reason that there is no completely adequate measure of the value of the Soviet paper currency. Its various relations to "valuta," or gold values, are fairly bewildering. Nominally about 50c. (an arbitrary rate, for foreign exchange at the border to a person entering, which has gone to 85 to 90c. since the appreciation in gold prices); 1 to 3c. in the Black Bourses of Germany, Poland, or Manchukuo, with the natives throughout the U.S.S.R. eager at all times to bootleg 40 to 55 for an American dollar, and with the menus of the large tourist hotels of Moscow and Leningrad carrying optional prices of $1 or 10 to 12 roubles for one and the same portion of food, the intrinsic value of the rouble is anybody's guess. To add to the confusion, remittances of "valuta" (any foreign currency) by friends or relatives to citizens within the U.S.S.R. are converted into credits at the Torgsin stores for arbitrary "Torgsin roubles," each of which has the equivalent purchasing power of 25 paper roubles.

In general, the range of copper production costs runs from 1,800 roubles in the Urals to 2,400 in Kazakstan-Caucasus. Out of the confusion of the various values for the rouble, its appraisal can best be reached from the average experience of foreigners during a year or two of actual living in the country; it procures for the spender in the long run about 10c. worth of assorted merchandise. It is a long cry from this statement, however, to even an approximate estimation of the production cost of Soviet copper. One would hesitate in more ways than one to convert, say, 2,000 roubles at a 10 to 1 ratio and conclude that the result represents the cost of a ton of Soviet copper.

In the accompanying tables, reserves which have been blocked out by mine development are placed in Category A. Category B represents those reserves proven by drilling. Categories C-1 and C-2 are "probable" and "possible" reserves respectively.

The Ural region is the most important in the Soviet copper industry and the most thoroughly prospected and developed. Its copper reserves, although amounting to about 25 per cent of the total reserves of the Soviet Union, have a particular significance in that approximately 75 to 80 per cent of the total present primary copper production (22,000 metric tons from the Urals in 1933) comes from this district. Zinc, as zinc blende, is associated with chalcopyrite in the pyrite orebodies of the Urals, and mills have been designed to recover it. In amount it constitutes approximately 23 per cent of the total zinc reserves in the Soviet Union. No orebodies carrying zinc alone are found, but in some deposits, as at the Levika mines in the Kalata district, zinc predominates.

On the eastern slope of the Urals is the main mineral-bearing zone of the region. The rocks composing it are Devonian sediments (slates, schist, limestone) associated with metamorphosed lavas, intrusive igneous rocks (gabbro, diabase, serpentine, diorite) and large areas of Pre-Cambrian granite and gneissic rocks. This zone contains the more important copper, zinc, and iron deposits as well as the gold and platinum of the region. On the Urals' western slope oxidized copper deposits are found in Permian and Carboniferous sedimentaries. The copper deposits of the Urals in general fall into six classes: copper pyrite ores; contact metamorphic deposits; copper magnetite; copper sandstone; copper disseminations in gabbro; and disseminations in diorite.

Of the six classes, the copper pyrite deposits are the most important, containing approximately 70 per cent of the district's copper reserves. These deposits were formed subsequent to the last regional metamorphism through metasomatic replacement of the schist, and consist chiefly of lenses conforming in dip and strike with the inclosing schist. They range in length from 100 meters to 4½ km., and in depth from several hundred meters (the roots of once deep lenses) to those 1,000 meters or more, as in the Karabash district. The ore is principally iron pyrite, chalcopyrite, zinc blende, galena, silver, and gold.

Deposits of the Karabash district (those of the former Kyshtim Estates) are concentrated in a narrow schist belt extending north and south for 8 miles. The orebodies strike north and south and dip east. There are four operating mines: the Vorshilovsky (formerly the Smironoff); the Pervomaisky (Americansky); the Djerinsky (Koniukoff);

and the Stalinsky (Tissoff). In addition, the Pioneersky (Ivanoff) and the Barinsky are conserved for future operations. Two other orebodies, the Kuznechinsky and the North Pervomaisky, are now being prospected. In all of them the copper occurs mainly as chalcopyrite and the zinc as blende.

The Djerinsky deposit dips 55 deg. and has a length of 1,050 ft. with an average width of 18 ft. It has been drilled by five holes to a vertical depth of 1,820 ft. At 751 ft. the copper content averages 3.4 per cent and zinc 1.7 per cent. Analyses of the drill holes at 1,820 ft. give copper 2.8 per cent and zinc 4.4 per cent.

The Voroshilovsky has two parallel lenses with a length of 2,340 ft. and an average width of 19 ft. The east lens at 725-ft. depth tends to pinch out, and the southern end of the western lens is mainly iron pyrite. This orebody has been drilled to a vertical depth of 1,470 ft., the analysis of the core giving 2.55 per cent copper, compared with 4 per cent on the upper working levels.

Mining operations are in progress at a vertical depth of 680 ft. on the Pervomaisky orebody, which has a length of 850 ft. and an average width of 10 ft. In addition, this orebody has been drilled to 1,580-ft. depth. The ore in the upper levels averages 4 per cent copper and 1.9 per cent zinc. At 1,580-ft. depth the copper content decreases to 3.8 per cent with an increase in zinc to 2.3 per cent.

In the Stalinsky deposit, which is 1,500 ft. long, with a maximum width of 90 ft., the copper, occurring as chalcopyrite with some traces of tennantite, is found as a vein within a vein in the north portion, the width of the copper-bearing vein being 12 ft. on the 340-ft. level. Copper content averages about 2 per cent. The south part as well as that on the north, save for the narrow vein of copper ore mentioned, is chiefly iron pyrite, and the mine is worked principally for its sulphur. It has been prospected to 1,270-ft. depth. At 780 ft. a wide impregnated zone was cut.

The Pioneersky deposit has two lenses, the west one being 300 ft. long and dipping east at 69 deg. The latter has been prospected to a vertical depth of 550 ft., where 6 ft. of ore averaged 1 per cent copper. Drilling on the east lens at a depth of 260 ft. cut 3 ft. of ore averaging 1.1 per cent copper.

North Pervomaisky is 1 km. north of the Pervomaisky deposit and is 300 ft. long. It has been drilled by twelve holes to a vertical depth of 650 ft., where the maximum width was found to be 19 ft., and the analyses of the cores averaged 2 per cent copper and 5.4 per cent zinc. This orebody, found in recent years, has the same north and south strike and dips east at 45 deg.

North and South Kuznechinsky orebodies are located 7.5 miles from Kyshtim. They strike north and south and dip east at 70 and 85 deg. respectively. The total length of the two is 3,250 ft., the widths varying from 1 to 10 ft. They have been drilled to a vertical depth of 465 ft., the analyses showing 1.6 per cent copper and 13 per cent zinc. The south orebody represents a series of small veins of copper ore, iron pyrite, and zinc ore in a wide impregnated zone.

In estimating the reserves for this district, the following depths have been taken: Probable ore (C-1 Category) is assumed to extend vertically to 2,200 ft. for all mines save the Djerinsky, which was calculated for a depth of 2,600 ft. The "possible" ore reserve (C-2 Category) was computed on the basis that the Stalinsky mine will extend to 2,600 ft.;

Mining districts in the Ural region

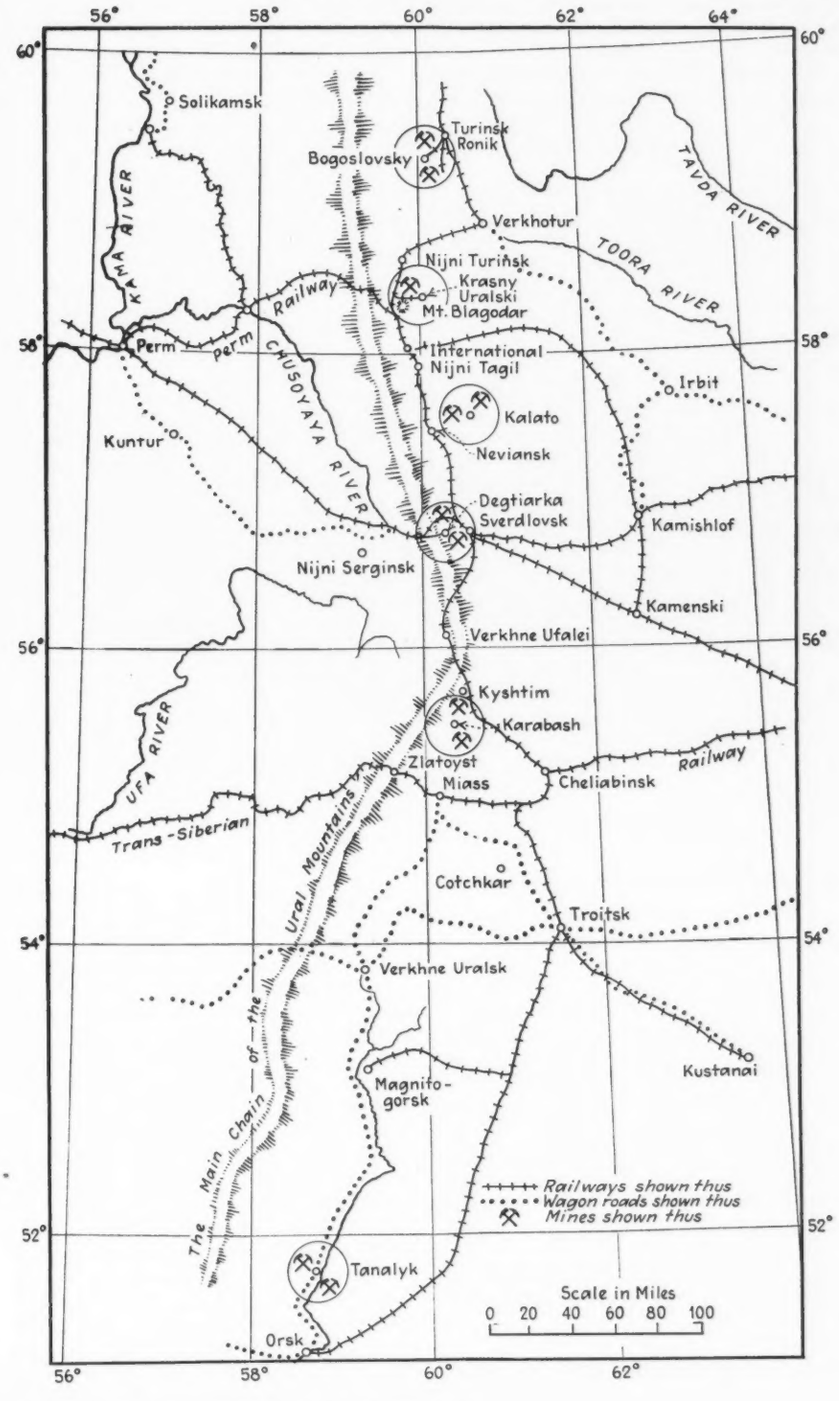


Table I—Average Grade of Ore in Karabash District

Orebodies	Copper, per Cent	Zinc, per Cent	Lead, per Cent	Iron, per Cent
Djerinsky	3.21	3.45	0.30	31.3
Vorshilovsky	2.55	2.44	0.17	39.5
Stalinsky	1.98	0.67	trace	40.7
Pervomaisky	3.9	2.10	....	....
N. Pervomaisky	2.0	5.4	....	....
Pioneersky	1.1	....	....	....
Kuznechinsky	1.6	13.0	....	....

the Vorshilovsky to 3,300; the Djerinsky to 3,200 and the Pervomaisky to 2,200.

Table I, which appears on page 549, gives the average grade of ore for this district.

In the Kalata and Degtiarka Districts

Operations in the Kalata district, which was formerly included in the Werkh-Issetsk estate directly south of the Krasnia Uralski district, are old, iron pyrite having been mined in 1813. In the western schist belt are the Karpushinsky and the Levika deposits, the latter groups being the most important of the district.

Twelve separate orebodies occur. These are known as the Levika 1, 2, 3, and so on. The largest of them, Levika 10, contains chiefly iron pyrite with little copper. The others of this group, although small, are characterized either by their high copper content, as for example Levika 9 and 11, or by their high zinc and copper, as Levika 2, 3, 4, and 12. The total reserve (all categories) of the Levika group is listed as 23,000,000 tons of ore averaging 1 per cent copper content.

Other copper deposits of this district are those situated in the eastern mineralized schist zone. The group comprises the Kalata, Oblavensky, Covelina, Bellorechinsk, and Ejievsky. These occurrences are of secondary importance.

Degtiarka district (Sreduralmedstroi), south of Kalata, was a part of the Sissert Estate before the revolution and more recently a part of the Lena Goldfields Concession. Its principal deposit is at Degtiarka, a small town on a branch line from Revda, which is on the main line of the Perm railroad. Extensive reduction facilities are projected for this Middle Urals Copper Combine in the next few years. A large new central smelter and mill, the latter of 14,000 tons' daily capacity, will be erected at Revda.

This deposit, an important one, has a length of 2.7 miles, and, although continuous, is irregular as to dip and width. Dip varies from 40 to 90 deg. and the width from 3 to 140 ft. (average 39 ft.). The south middle part of the deposit, where the greatest widths are shown, has been opened by four shafts, the deepest (London) having been sunk to 430 ft. Stoping has been confined to an area 2,000 ft. long and 220 deep. The rest of the orebody is now under development. This deposit has been drilled by 72 holes to a depth of 475 to 750 ft. vertically and by one hole to 1,130 ft.

A typical analysis of the ore of the Degtiarka mine is as follows: Copper, 1.42 per cent; sulphur, 47; iron 38.47; zinc, 0.24; and barite, 4.5.

Much attention is directed by the Soviet Government to this deposit, and the mine is to have a production of 4,500,000 metric tons annually before the end of 1927.

Other deposits in this district are the Panavsky, Rebneovsky, Chalchedonia, Bereovsogorsky, and Gumechevsky. The last was discovered in 1727, but has been closed since 1871. The deepest workings on it are on the 500-ft. level.

During recent years much attention has been given by the government to the Krasnia Uralski district (Uralmedstroi), north of the Kalata section. More than 40,000,000 roubles has been spent on the construction of a modern mill, smelter, and town. The principal orebodies, the Krasnia Gvardeiski ("Kompaneyski" of pre-revolutionary days), and the Novo Levinski, occur in a mineralized schist zone, which is practically continuous from the Karabash district.

At these properties, copper-bearing pyrite occurs in the form of lenses in a highly altered argillaceous schist, which at the contact is nearly white. These orebodies were found by the Bogoslovsk Mining Company in 1915 after pyrite had been discovered under the gossan, which was worked for years for its gold content.

Although the Krasnia Gvardeiski deposit has been prospected to a depth of 810 ft., it is expected to have a depth of 1,700 ft. It includes three lenticular bodies having a total length of approximately 1,000 ft. and a maximum width of 210 ft. on the 403-ft. level. The lenses strike N. 24 deg. W. and dip east at 70 deg. The average assays of the drill holes show the following: Copper, 2 per cent (from traces to 12 per cent); silica, 10 per cent; iron, 40 per cent; lime (CaO), 1 per cent; and sulphur, 40 per cent.

The Novo Levinsky orebody has been prospected thoroughly to 720-ft. depth and also has three lenticular bodies, with a total length of 660 ft. and a maximum width of 130 ft.

In addition to the principal orebodies mentioned, some other deposits of lesser importance occur. The Spasso-Sernia-Chalchedonia orebody is 1,600 ft. long and has been worked to a depth of 825 ft. Up to 1931, it was considered to be purely iron pyrite, but drilling at a depth of 1,055 ft. cut a small lens of copper-bearing pyrite averaging 5.18 per cent copper.

Other Occurrences

Besides these, other indications of copper are found in the Kaban, Yesvi, and Pavdi Mountains in this district, where further prospecting may disclose commercial deposits.

Copper occurrences in the Pishma district, 10 miles from Sverdlovsk (formerly Ekaterinburg), comprise a small group of orebodies and zones of dissemination varying from 8 in. to 6 ft. in width. The most important are the Alexandrovsky, the Pokrovsky, and the Ivanovsky (representing 90 per cent of the ore). The district's future is not particularly bright, as intensive prospecting in the past few years has not given favorable results. A 500-ton flotation plant has recently been built here, but its ore supply comes largely from Degtiarka.

Seventy-five miles north of Sara, a station on the Orenburg-Troitsk Railroad, in the South Urals, is the Tanalyk Baimak district. It includes a number of deposits in Devonian schist, the geological formation being similar to that farther north. The ores, containing copper and zinc, are characterized by their relatively high gold and copper content. Operating mines are the Turinski, Ulalinsky, Burabai and Bakrusak. Other known deposits which have been prospected to a considerable extent are the Cebi and Uluk.

Deposits of the second class mentioned—namely, contact metamorphic—are represented by those of the Turinski district, which have been reopened in recent years to permit extraction of the low-grade ore left in the footwall. This district, which was formerly

Table II—Ural Region Copper Reserves

Name of District	Metric Tons Ore Tons	Average % Copper	Category A B	C-1	C-2	Total
Karabash	17,300,000	2.26	165,200	78,000	147,800	391,000
Kalata	33,400,000	1.41	130,000	78,000	263,600	471,600
Krasnia-Uralski	14,130,000	2.22	210,000	53,600	50,000	313,600
Degtiarka	73,050,000	1.36	423,600	246,300	330,000	999,900
Blava (a) (or Middle Volga)	.....	....	.....	150,000	350,000	500,000
Pishma	2,330,000	2.1	25,000	5,000	19,000	49,000
Baimak	16,500,000	2.14	179,200	48,500	125,000	352,700
Contact Deposits	3,110,000	3.5	6,000	14,000	89,000	109,000
Copper Magnetite Deposits	29,000,000	1.0	.....	40,000	250,000	290,000
Copper Sandstone Deposits	18,660,000	1.5	50,000	10,000	220,000	280,000
Disseminations in Gabbro	24,500,000	0.8	40,000	.....	150,000	190,000
Disseminations in Diorite	14,000,000	0.6	.....	40,000	44,000	84,000
Totals	245,980,000		1,229,000	763,400	2,038,400	4,030,800

(a) The Blava deposit at the southern end of the Urals, 5 miles from Station Blava, on Oronburg-Orsk Railroad, although reported to be of considerable size and value, has been insufficiently prospected to give average copper content and final tonnage. An October (1934) issue of Moscow "Pravda" claims 630,000 tons of copper metal for this "Middle Volga region" but gives no grade or tonnage.

a part of the holdings of the Bogoslovsk Mining Company, is in the North Urals several miles from Nadejinsk. The ores, of siliceous character carrying chalcopyrite and pyrrhotite, bornite, native copper, iron pyrite, and magnetite, occur associated with augite-garnet rocks at the contact of porphyry and limestone. The deposits occur in a belt three miles long and, in general, strike slightly west of north. As this district, originally exploited 150 years ago, has been idle for many years, the work of reopening is slow and costly. Some of the mines were believed to be worked out before the revolution, but the Soviet law compelling the working of low-grade deposits makes it necessary for the old mines to be reopened. Future prospecting of the district will be slow and expensive, due to the relatively small orebodies lying at depth and the slow speed of development work in the tough augite-garnet rock. In addition to these known deposits, a large unexplored area near by is under suspicion. The three larger orebodies of earlier years are the Bashmovsky, Bogoslovsky (5 per cent copper), and Vasilevsky. The ore of the latter is spotty but of higher copper content than the other two. Several smaller contact deposits were worked in the past, such as the Frolovsky, Sokoldosky, and Nikitinsky.

Of the copper magnetite deposits (the third class) the most important are the Auerbach, Third North Mine, and the Gora Vysokaia (Middle Urals). Although it is hoped that the problem of extracting the copper from this ore has been solved and that the residue may be used in conjunction with the Ferrous Metal Trust, the latter has had difficulty with this type of deposit, and it is doubtful whether these ores will be of great economic importance for some years to come. The copper content is low.

As for the copper sandstone deposits mentioned, hundreds of small, irregular deposits occurring in Permian sandstone have been traced along the western slope of the Urals for 1,000 km. They vary in depth from 234 ft. to those found on the surface; and as a general rule lie nearly horizontal. At present, they have little economic importance.

Copper disseminations in gabbro are found at the Volkovsky mine, in the Krasnia Uralski district. This deposit has long been known, but it was only recently prospected to any extent. Local belief now holds that in an area of 1½ sq.km. drilling has shown where this low-grade ore can be mined profitably by introducing large-scale methods.

Bodies of diorite containing disseminated copper were found in 1931 in the old Vosnesensk deposit, in the Uchalinsk district, in Bashkiria, but to date these have been insufficiently explored.

Table II shows the reserve of copper in the Ural region.

Any future increase in the copper reserves of the Urals will not be of large degree. The Second Five Year Plan calls for the expenditure of 90,000,000 roubles (approximately $76,000,000 at the present rate of exchange) for prospecting in this region, but this sum will be spent largely on making detailed studies of the known orebodies. The only notable discovery of a copper deposit in this region in 1934 occurred in the Karabash district, where a copper-pyrite deposit approximately 20 meters wide was found.

Modern flotation mills have been erected at Pishma, Krasnia-Uralski, Degtiarka, and Kalata. Operating smelters are at Karabash, Kalata, Baimak, and Krasnia-Uralski. Electrolytic plants are at Pishma and Kyshtim.

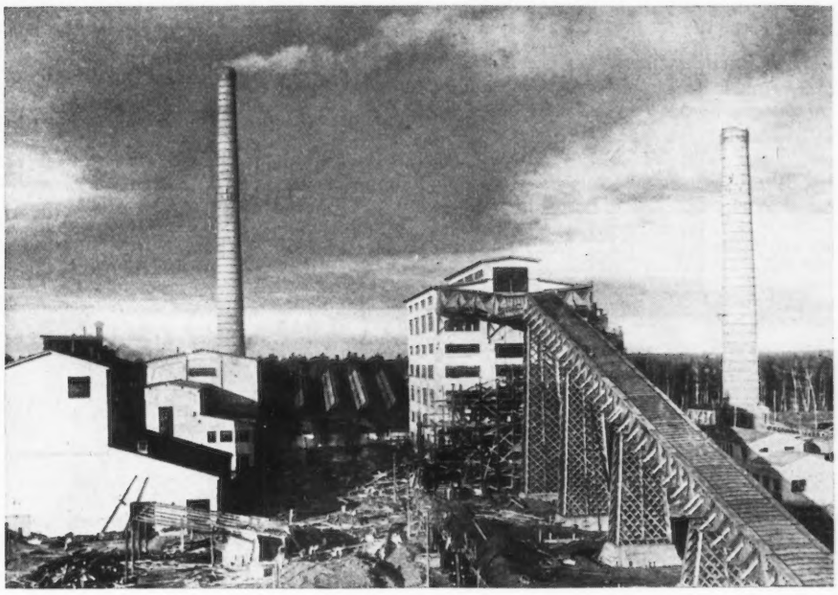
With the exception of Baimak, the copper districts of this region are adequately served by the railroads. In the matter of supplies, the region has an abundance of timber, water, fuel, and labor.

One can see from Table II that approximately 50 per cent of the reserves of copper in the Ural region are somewhat conjectural. Despite this, plans have been completed and construction is aggressively in progress toward an ultimate production of 200,000 metric tons of copper annually from this district. If a recovery of 80 to 85 per cent be assumed, and only the actual and probable reserves of copper be considered, the district at the stated rate of production would have a life of something like eight years.

Under ordinarily accepted principles of mine development in other lands, this intensive program of Ural construction would be considered ill-advised. The normal foreign mine owner, influenced primarily by limitations as to costs of production and the matter of depreciation, would, under all the physical conditions involved in the Ural region, and with ore reserves and locations as at present determined, probably prepare for an annual copper output of 75,000 tons or less. Soviet industrial economy has unique principles and flexibility, however; tempo and central ownership demand and encourage unusual business risks. Metal districts and programs all over the country are being rushed along in a novel simultaneous development of reduction equipment and raw materials, at which the engineer trained in another economic system sometimes stands aghast.

Drilling campaigns in the past have been handicapped by the lack of proper equipment for deep holes, by the dependence on shot for abrasion, the worn-out condition of the drilling equipment and the difficulty of repairing it. In Soviet copper circles, however, the hope is expressed that the prospecting and drilling campaign of the Second "Piatiletka" or Five Year Plan (1933-1937) will increase the reserves of Ural copper to some 6,000,000 tons for all categories.

The remaining copper districts of U.S.S.R.—namely, Kazakstan and Central Asia, Siberia, Trans-Caucasus, and the Kola Peninsula, comprising 75 per cent of the Soviet reserves—will be described in a separate article in an early issue.



The plant at Sverdlovsk has an annual capacity of 100,000 tons of fabricated copper

Trajectories From Conveyors

Method of Calculating Them Corrected

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WHILE investigating the trajectory of material leaving the head pulley of a conveyor belt for the purpose of installing a sample cutter, discovery was made that, between the actual trajectory and that calculated according to accepted theory, a rather serious discrepancy appeared. This being unaccountable, provided the basic theory was assumed correct, several other conveyors were investigated, with similar results. In all cases the calculated trajectory was found to lie between the pulley and the actual trajectory as shown in Fig. 1. At first we thought that this might be due to a combination of small errors, such as overspeeding of the belt or crowning

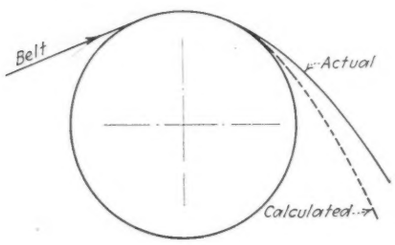


Fig. 1

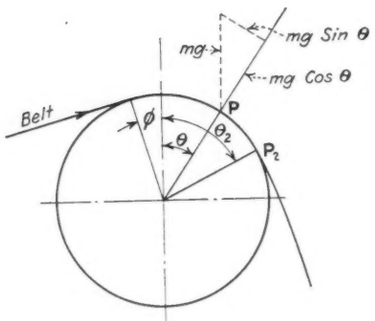


Fig. 2

of the head pulley. Careful allowance was therefore made for all of these, but the corrected results were shown to exhibit the same difference to almost the same degree.

Because of this experience, the existing accepted theory was investigated (as follows) and the following conclusion reached:

Theory as published appears incomplete, inasmuch as it does not allow for the effects of the slipping of the material while it is going over the head pulley. One can prove that this will always take place, provided the material remains on the belt past the apex of the pulley. To do so it is probably best to investigate the theory from the beginning.

In Fig. 2 is shown a particle P of mass m moving over a pulley of radius R. V is the velocity of the particle and g the acceleration due to gravity. To provide the centrifugal acceleration, $\frac{V^2}{gR}$, and keep the particle on the belt, we must apply an inward radial force that is greater than $\frac{mV^2}{R}$. (If the particle is free on the belt this force must be supplied by the radial component of its weight)

$$\therefore mg \cos \theta > \frac{mV^2}{R}$$

Cos θ decreases as θ increases, so that the particle will leave the pulley when $mg \cos \theta = \frac{mV^2}{R}$.

That is, $\cos \theta_2 = \frac{V^2}{gR}$ (1)

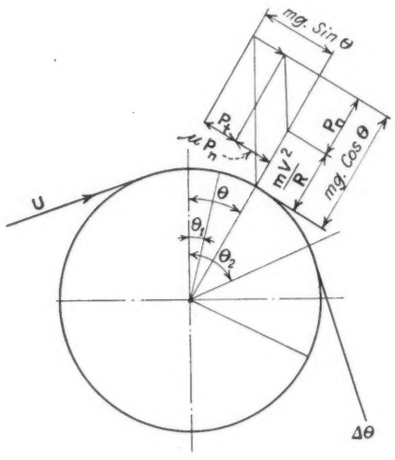


Fig. 3

If $\frac{V^2}{gR}$ is greater than cos ϕ, the particle will leave the belt as soon as the head pulley is reached, its trajectory being tangent to the belt line at this point.

V, the velocity of the particle, or in practice of the ribbon of material on the belt, is generally taken as the velocity of the belt, (U). On this basis, and using formula (1), the starting point of the trajectory is generally calculated.

To justify the assumption that $V = U$, one must prove that from the point where the pulley is reached to P_2 the passive frictional resistance to slipping between the material and the belt is greater than the component of the weight of the material tangent to the belt.

In Fig. 2 the net radial force between particle and belt is $\left(mg \cos \theta - \frac{mV^2}{R}\right)$.

Let μ be coefficient of friction of material on the belt. Then for no slipping $\mu\left(mg \cos \theta - \frac{mV^2}{R}\right) > mg \sin \theta$, or slipping would just commence when

$$\mu\left(mg \cos \theta - \frac{mV^2}{R}\right) = mg \sin \theta$$

That is

$$\cos \theta_1 - \frac{V^2}{gR} = \frac{1}{\mu} \sin \theta_1 \qquad (2)$$

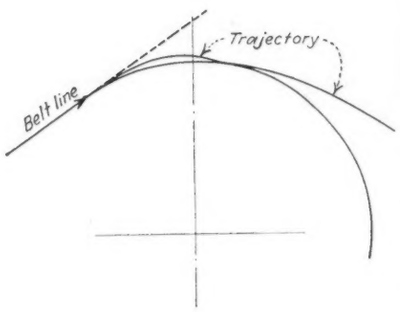


Fig. 4

Applying this to a practical case for the sake of illustration,

$V = U = 360$ ft. per min. $= 6$ ft. per sec.
$R = 1.75$ ft. $g = 32.2$ ft. per sec.^{2} $\mu = 0.55$

Then $\frac{V^2}{gR} = \frac{36}{1.75 \times 32.2} =$

$$0.639 = \cos \theta_1 - \frac{1}{0.55} \sin \theta_1$$

$\theta_1 = 11$ deg. approximately

To calculate, for this same case, the angle θ_2 at which the particle should

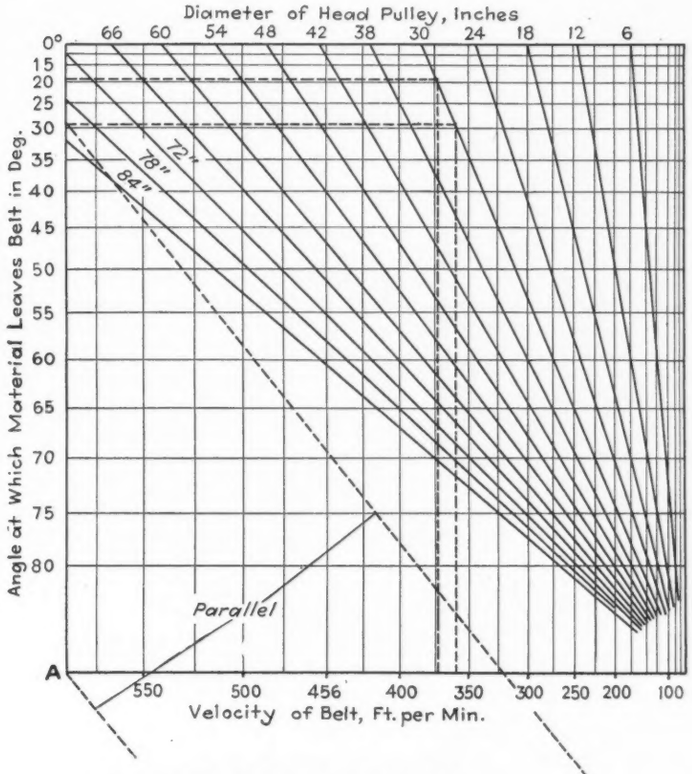
leave the belt, assuming $V = U$, substitute in Equation (1)

$$\cos\theta_2 = \frac{V^2}{gR} = \frac{U^2}{gR} = \frac{36}{1.71 \times 32.2} = 0.639$$

This would give $\theta_2 = 50.5$ deg.

We can see from the foregoing that in this case the material would begin to slip on the belt considerably before it theoretically should leave it. Also, inspecting the equations (1) and (2), as $\frac{1}{\mu} \sin\theta$ is positive. Hence θ_2 will always be greater than θ_1; therefore, there will always be some period of slipping.

We can now deduce from the foregoing the following: After an angle of θ_1 from the vertical, V would begin to increase in value, and on the particle


Diameter of Head Pulley, Inches
66 60 54 48 42 38 30 24 18 12 6
0° 15 20 25 30 35 40 45 50 55 60 65 70 75 80
Angle at Which Material Leaves Belt in Deg.
72"
78"
84"
Parallel
A
550 500 456 400 350 300 250 200 100
Velocity of Belt, Ft. per Min.

DETERMINATION OF TRAJECTORY OF MATERIAL DISCHARGING FROM A CONVEYOR HEAD PULLEY

THIS CHART is designed to give the angle at which a dry material, such as crushed rock, will leave the head pulley of a belt conveyor; also its velocity at this point, if the diameter of the head pulley and the speed of the belt be known. It is designed to take into account the slippage of the material on the belt as it passes over the pulley.

ENTER THE CHART with the velocity of the belt in ft./min. Move up to the radial line representing the diameter of the head pulley. Move horizontally to the extreme left of the diagram. From this point draw a line tangent to the curved line on the lower right. From the point *A* draw a line, parallel to this, to cut the vertical line at the bottom of the diagram. Here read off the value of the angle at which the material leaves the belt. To determine the velocity, enter with this angle the chart at the top left. Move horizontally to intersect the radial line corresponding to the pulley diameter. Then move vertically downwards and read off the velocity at which the material leaves the belt. If the lines representing belt velocity and pulley diameter intersect above the top of the chart, start the trajectory horizontally from the apex of the pulley, or in the extended line of the belt, whichever throws farthest out from the head pulley, using the belt velocity to determine *L*.

TO PLOT THE TRAJECTORY

(See Fig. A below)

DRAW A CIRCLE, to a convenient scale, of a diameter equal to that of the head pulley plus the belt thickness. Lay off from the vertical the angle at which the material leaves the belt. Where this cuts the circumference draw a tangent. Along this line, starting at *P*, mark off equal spaces of length

$$L = \frac{1 \text{ in.} \times \textit{Velocity of the material leaving pulley}}{100}$$

numbering these points 1. 2. 3. 4. 5. . . . From them drop ordinates corresponding to those in the accompanying table, and a smooth curve drawn through the bases of these will be the required trajectory.

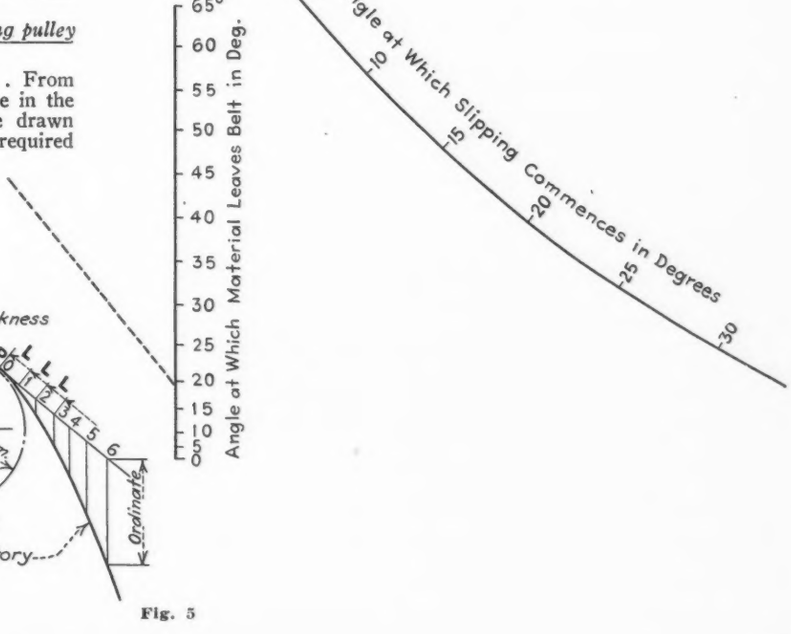


TABLE OF ORDINATES

No.	Ord., In.
1	¼
2	1¼
3	4¼
4	7¼
5	12½
6	17⅝
7	23⅝
8	30⅞
9	39½
10	48½
11	58⅝
12	69½
13	81⅞
14	94½
15	108½

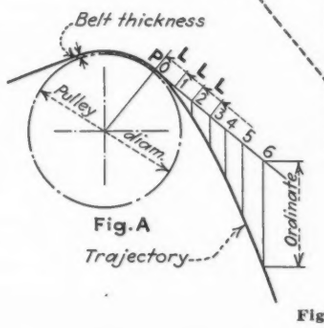


Fig.A

Fig. 5

leaving the belt would be greater than U; therefore, the angle θ_2 would be correspondingly reduced; this in turn throwing the trajectory further out from the head pulley.

Comparing this deduction with Fig. 1 we see at once how it is borne out by practical observations.

To analyze the motion after slipping starts, consider Fig. 3. The force normal to the belt surface $P_n = mg \cos \theta - \frac{mV^2}{R}$. With slipping taking place, the net tangential force will be: $mg \sin \theta - \mu \times$ normal force. Therefore $Pt = mg \sin \theta - \mu \left(mg \cos \theta - \frac{mV^2}{R} \right)$.

Consider an increase in the angle from θ to $\theta + \Delta\theta$ being very small, so that the forces acting on the particle could be assumed constant through this interval.

Then let V increase correspondingly to $V + \Delta V$. We have $(V + \Delta V)^2 - V^2 = 2 \frac{Pt.}{m} R \Delta\theta$.

Expanding and eliminating differentials of higher than the first power we get:

$$2\,V.\,\Delta\,V = 2\,\frac{P_t.}{m}\,R\,\Delta\theta$$

or

$$2\,V.\,\frac{\Delta\,V}{\Delta\,\theta} = 2\,\frac{P_t.}{m}\,R.$$

In the limiting case we get the differential equation: $2\,V.\,\frac{dV}{d\theta} = 2\,\frac{P_t.R.}{m.}$

Substituting for P_t.

$$2\,V.\,\frac{dV}{d\theta} = \frac{2R}{m}\left(mg \sin\theta - \mu\left[mg\cos\theta - \frac{mV^2}{R}\right]\right)$$

$$V\,\frac{dV}{d\theta} - \mu V^2 = (Rg \sin\theta - R\mu g \cos\theta) \quad (3)$$

Equation 3 gives the following solution:

$$\frac{V^2}{2.g.R} = \frac{(2\mu^2 - 1)\cos\theta - 3\mu\sin\theta}{(4\mu^2 + 1.)} + C\,e^{2\mu\theta} \quad (4)$$

C is a constant of integration.

In any particular case, to solve for C, substitute values found for when slipping commences from Equation (2); thus U for V and θ_1 for θ.

Then, knowing C in Equation (4), if we solve equations (1) and (4) simultaneously we will get the value of V_2 and θ_2 for the point at which the particle will leave the belt. From this point plotting the trajectory is comparatively simple and an excellent standard method is given in most conveyor handbooks.

In practice, the method of determining V_2 and θ_2 outlined in the foregoing would be both tedious and complicated, so the alignment chart presented herewith has been prepared, which gives the solution with the minimum of labor.

To show how the trajectories calculated in this manner agree with those actually determined from practical cases,

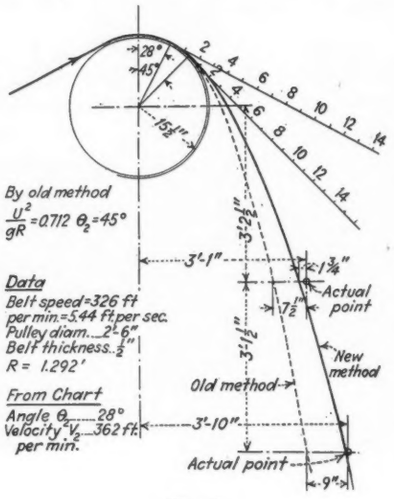


Fig. 6

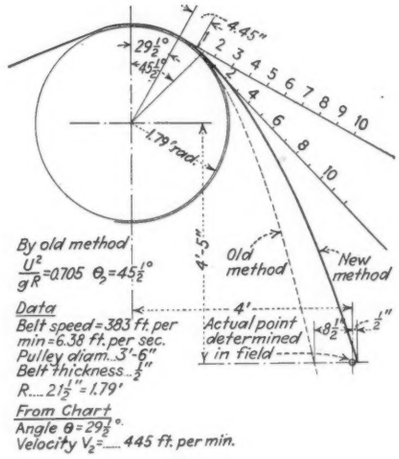


Fig. 7

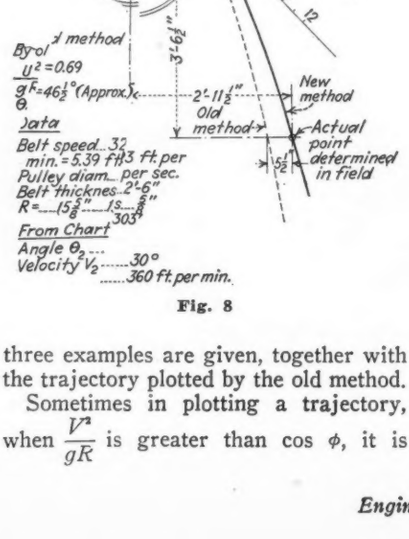


Fig. 8

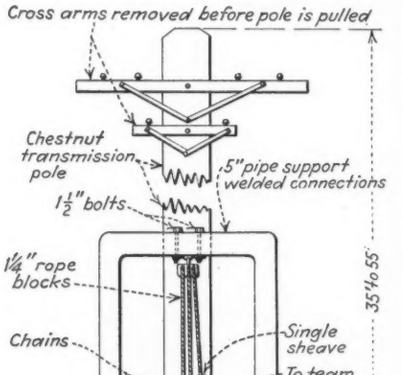
three examples are given, together with the trajectory plotted by the old method.

Sometimes in plotting a trajectory, when $\frac{V^2}{gR}$ is greater than $\cos\phi$, it is found that the calculated trajectory intersects the belt line further on. In this case the material actually bounces on the belt as shown diagrammatically in Fig. 4; and the assumption that the trajectory starts from the apex of the belt line, horizontally and with velocity U, will be found reasonably correct.

◆

Removing Heavy Wooden Poles From Their Holes

HAVING only a minimum of time and a rocky ground condition necessitated the use of a quick and efficient method of removing heavy chestnut poles from their position in an electrical transmission line in Southeast Missouri, writes Roy H. Poston, Flat



Detail of the application of the method

River, Mo. A procedure was evolved, as indicated by the accompanying sketch, that made removal comparatively easy and had the further advantage of leaving the hole practically clean for the insertion of new poles in the old holes.

A special support of 5-in. pipe was made up in a local shop, the only other equipment used being a set of 1.25-in. manila rope, triple-sheave tackle blocks, a single sheave of the same size, and two log chains, plus a team of mules. The assembly of the mechanical equipment is shown in the sketch. Direction of pull is parallel to the transmission line, the poles falling between the wires with the top end toward the pulling team.

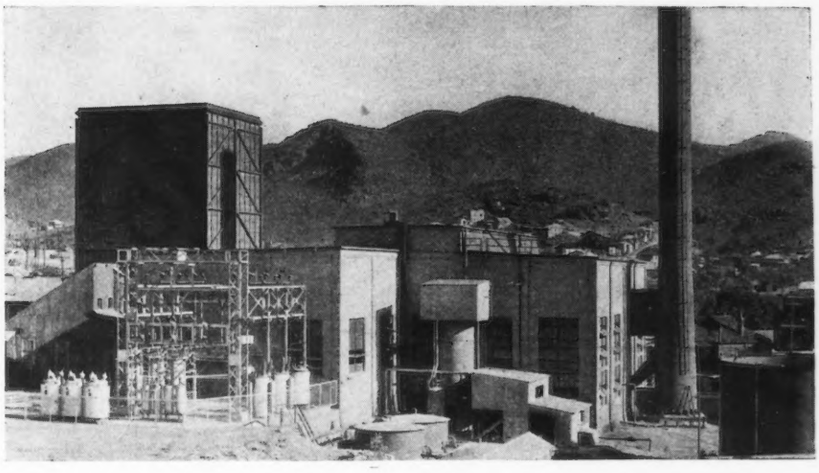
This method had the further advantage of enabling the removal of poles to be made without the use of men and pike poles, a safety feature worthy of consideration.

Generating Power

At the Junction Mine

A company-operated plant, tied in with the local public utility to the latter's benefit, provides effective service with up-to-date equipment

The Junction power plant of the Phelps Dodge Corporation, at Lowell, Ariz. Besides the steam and electric power equipment, it also houses three mine compressors



A. C. Reifsnider and *Don Allen*

Master Mechanic *Power Plant Engineer*

Phelps Dodge Corporation
Bisbee, Ariz.

CURIOUSLY, though the Phelps Dodge Corporation's Junction power plant, at Lowell, Ariz., has a tie-in with utility service, the latter has never been relied upon for mining operations; instead, it is the public utility company which depends on the 3,750-kva. turbine generator in the mine power house for emergency service. Occasion for this arises when the utility company finds it necessary to have all of its engines down or when it is working on its high-pressure line between its power plant and distributing station.

Originally, the Junction plant was intended as a standby, the waste-heat plant at the smelter, at Douglas, being supposed to carry most of the normal loads for all mines operating two shifts per day, with pumping, ventilation, and, in some places, hoisting proceeding three shifts per day. The plant was put into operation in May, 1930. During its first year the boilers furnished 500,000 lb. of steam daily to steam equipment, consisting principally of hoists and compressors at the Junction mine. Subsequently, the steam demand was lightened by the substitution of motor-driven hoists and compressors for the older machinery, and at present all steam generated is used in main turbine and plant auxiliaries. Naturally, the boilers are not now working at capacity. Approximately 40 per cent of the electric power produced is being used to operate the hoists and compressors and the remainder for carrying the mine pump and miscellaneous electric load. The latter includes mine ventilation, shop service, surface lighting, and minor uses.

The steam generators consist of two 725-hp. Hedges, Walsh, and Wiedner single cross-drum, sectional headers, water-tube boilers equipped with Elessco superheater units. These are built for 400-lb. working pressure and 200 deg. of superheat. The designers evidently selected these points as being the most economical and in line with current practice. The boiler setting is of the standard solid-wall type, with the boilers hung from the steel supporting structure. At present, the plant is operated under 370-lb. steam pressure and 150 deg. of superheat. The maximum rating obtained is 250 per cent with 204 deg. of superheat, equal to 53,500 lb. of steam per hour with water at 250 deg. F.

Both boilers are fired under normal operation at an average rating of 100 per cent. This average is arrived at as giving the lowest B.t.u. per kilowatt generated and lowest maintenance cost on boilers and boiler furnace. To operate at peak capacity the plant requires a boiler rating of 120 per cent. The furnaces are fired with natural gas, giving 1,080 B.t.u. per cubic foot, through four burners on a line in front of the furnaces. The burners are of the combination gas and oil type, with air registers. Normally, gas firing is employed, oil serving as a standby. Combustion control is automatic, handled by an air-operated master sender and one receiving machine on each boiler. The master machine is actuated by the pressure of the main steam header. Combustion is checked by a continuous CO_2 recorder.

Each boiler is equipped with a double-suction forced-draft fan having a capacity of 20,000 cu.ft. per minute and driven by a 40-hp., 1,750-r.p.m., 440-volt motor. A third forced-draft fan is provided for supplying both or either of the boilers in case of emergency. It has a capacity of 56,000 cu.ft. per minute and is driven by a 60-hp., 1,750-r.p.m. turbine with 400-lb. maximum steam pressure at throttle. One induced-draft fan takes care of both boilers on the higher rating. Dampers are automatically handled by air-operated machines of the balanced-control type. Water level in the boilers is controlled by automatic valves with a differential pressure valve completing the unit.

Each boiler is equipped with a steam flow meter of the chart and integrator type with rating pen, air pen, and stack-temperature pen. In fact, all steam, water, and gas flows in the plant are metered and the temperatures recorded.

Steam piping throughout is extra heavy, lap-welded. All other piping is standard. Van Stone joints are used on the steam lines, and standard screwed and flanged joints on the others.

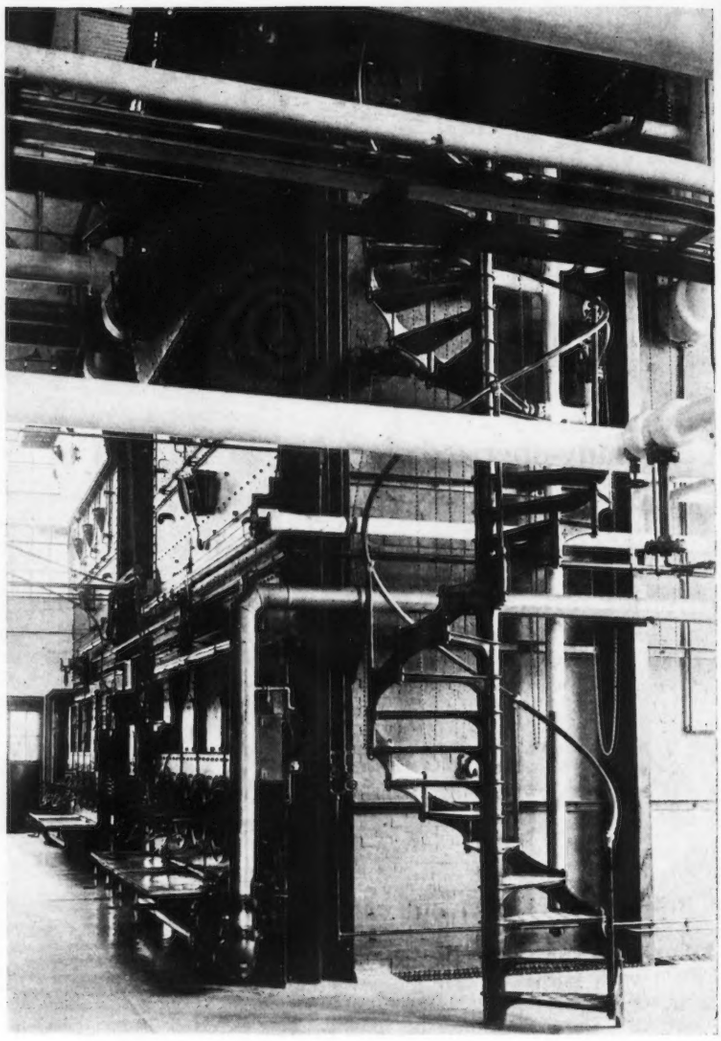
The raw-water make-up, which is less than 5 per cent, is treated with lime and soda in a 6,000 gal. per hour hot-process combination deaërating heater and storage tank. The lime and soda are fed by chemical pumps, which are supplied by a chemical proportioner. When treated, the water is passed through a filter before going to the feed-water heater. The condensate has a separate compartment in the heater, where its temperature is raised by exhaust steam. Condensate and treated water combine

in the booster pump suction. Also, at this point, an average of 1.5 lb. of trisodium phosphate is fed daily.

Two booster pumps are provided to handle condensate and treated water between the treater and the feed-water heater. One of them is a steam-driven 8x8x12-in. duplex inside-packed pump with 160-lb. pressure at 100 deg. superheat at the throttle, a constant-pressure control valve holding the discharge pressure to 100-lb. gage. This pump is run in daily operation. A 3-in. single-stage centrifugal pump driven by a 30-hp., 440-volt, 1,750-r.p.m. motor is used for an emergency booster and filter backwash. In the feed-water heater the water level is controlled by a float, a pilot valve working a water-operated control valve on the pump discharge.

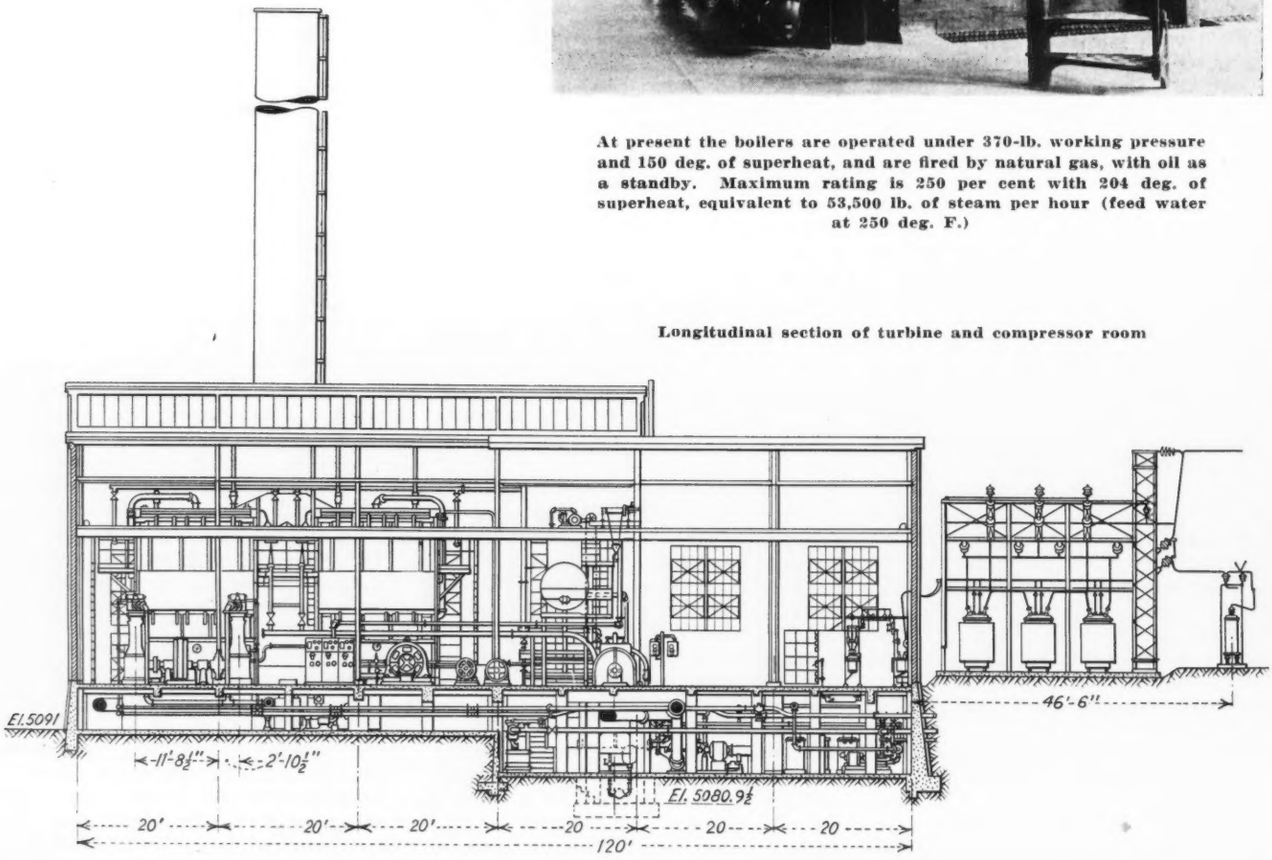
The closed, deaërating feed-water heater and storage tank is under pressure ranging up to a maximum of 75-lb. gage. This pressure varies with the load on the main turbine as steam for heating the feed water is extracted from the turbine through a bleeder line. Feed-water temperature averages 290 deg. F. Steam is bled from the turbine only for heating the feed-water.

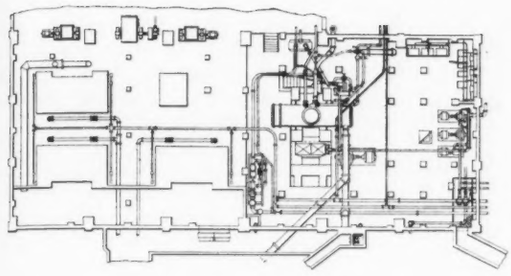
Between the heater and the boilers the feed-water is handled by one of two 14x7x12-in. duplex outside plunger pumps, working alternately, with 160-lb. pressure at 100 deg. of superheat at the throttle. There is also a standby pump —a four-stage centrifugal feed pump



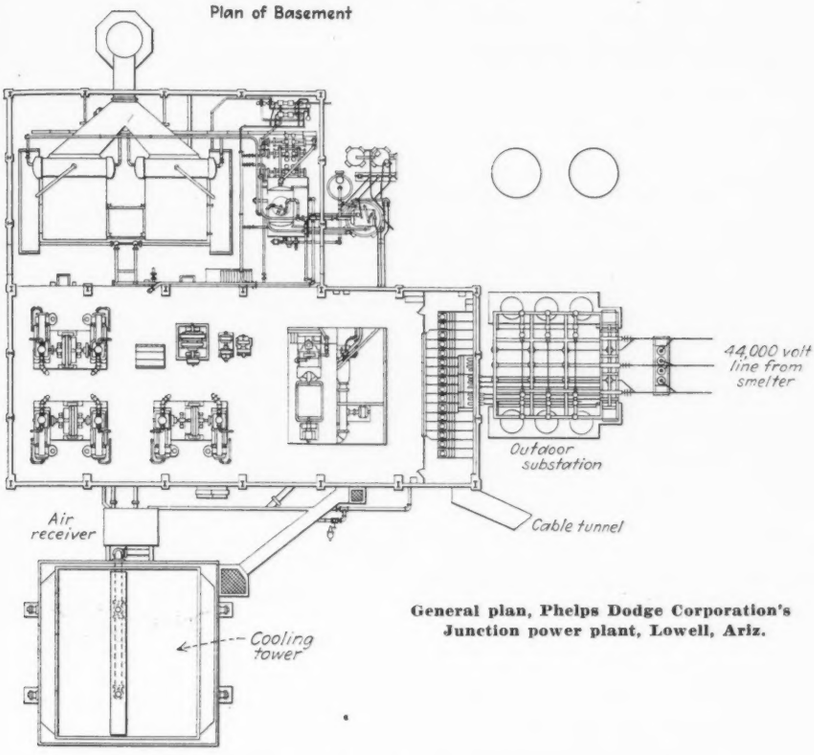
At present the boilers are operated under 370-lb. working pressure and 150 deg. of superheat, and are fired by natural gas, with oil as a standby. Maximum rating is 250 per cent with 204 deg. of superheat, equivalent to 53,500 lb. of steam per hour (feed water at 250 deg. F.)

Longitudinal section of turbine and compressor room



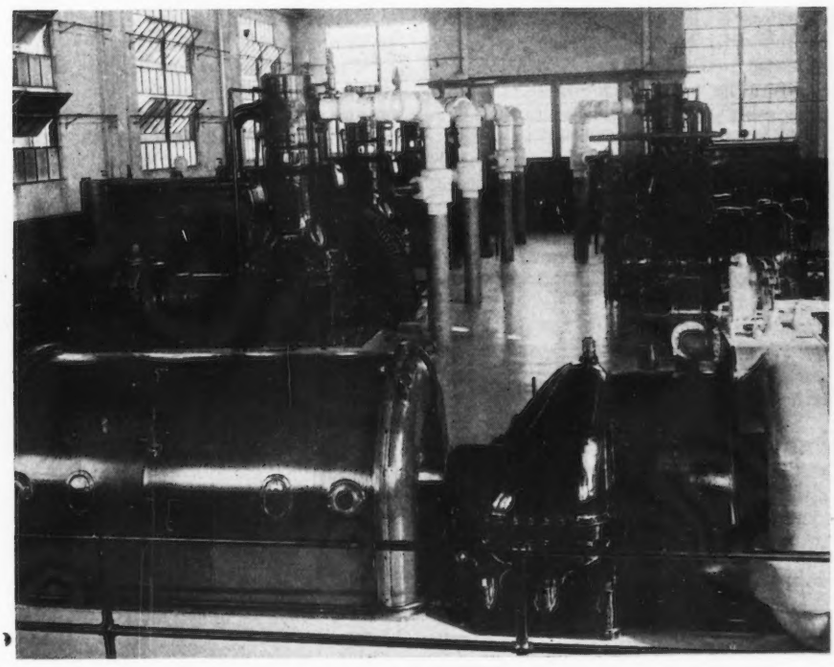


Plan of Basement



General plan, Phelps Dodge Corporation's Junction power plant, Lowell, Ariz.

The turbo-generator and, in the background, the compressors. This turbine is of the bleeder-and-condensing type, with 350-lb. minimum steam pressure and 200 deg. of superheat at the throttle



driven by a 135-hp., 3,500-r.p.m. turbine with high-pressure steam at the throttle. This pump is used at present only in case of auxiliary steam failure. Feed-pump pressures are controlled to 400-lb. gage by constant-pressure control valves.

The main turbine is of the bleeder and condensing type with 400-lb. maximum and 350-lb. minimum steam pressure and 200 deg. of superheat at the throttle. It drives a 3,750-kva., 3,600-r.p.m., 60-cycle, 2,400-volt a.c. generator with a direct-connected exciter. A spare exciter is also provided in case of exciter trouble. The yearly plant average heat rate is 19,700 B.t.u. per (gross) kilowatt-hour. Both the turbine and the generator are of Westinghouse make.

The generator is air-cooled by a closed air duct with a six-pass fin water cooler inserted to cool the air. Oil for the turbine and generator bearings is cooled by a two-pass vertical cooler.

A 5,350-sq.ft. surface condenser with spring supports serves the turbine. Circulating water is supplied by a double-suction single-stage centrifugal pump, delivering 6,000 g.p.m. and driven by a 100-hp., 2,200-volt motor.

Circulating water is cooled in a Foster-Wheeler four-cell tower, 44x36x80 ft. in dimensions. Each cell has a forced-draft aëro-type fan, 11 ft. in diameter and driven by a 20-hp., 440-volt, 575-r.p.m. enclosed-type motor. All of the cooling tower make-up is filtered. The circulating water is treated so as to maintain a low alkalinity, and enough water is drawn out of the system to keep the concentration down. No scale or sludge is found in the condenser tubes.

Two condensate pumps are provided, one driven by steam and the other electrically. The latter is used in normal operation and the steam pump in an emergency. The condenser is equipped with a twin combination air ejector having 150-lb. pressure at the jets. Condensate and treated water are used through the cooling tubes.

After passing through the air ejector the condensate is passed through a six-pass horizontal heat exchanger or closed heater. Steam is drawn from a low pressure bleeder, the pressure ranging from 1 lb. absolute to 5-lb. gage to heat the condensate further. Steam leakage from the turbine is also piped to this heater.

The three compressor units are identical except that one of them is equipped with a magnetic clutch, so that at a time of low air demand only half the unit may be run. Each unit consists of a twin angle-compound Sullivan compressor driven by a 700-hp., 2,200-volt, 225-r.p.m. Westinghouse synchronous motor direct-connected in the center. Each unit displacement is 4,400 cu.ft. of free air and compresses air to 100-lb. gage.

In the plant, there are two d.c. current generators, one of 625-amp. capacity and one of 200-amp. capacity at 250 volts, driven by 2,200-volt a.c. motors. This current is used mainly for mine haulage.

Colloidal Depressors

In Soap Flotation

Some Worth-while Observations on a Live Subject—The Metallurgical Reader Will Find It Interesting to Check Them Against His Own Experience

John Mark Patek

2664 North Hackett Ave., Milwaukee, Wis.

SOAP FLOTATION involves the use of a saponifiable organic collecting agent. The collecting action is dependent upon the presence of the organic substance, generally a fatty acid, such as oleic acid, and is greatest when the solution is neutral rather than alkaline. With the fatty acid collector is commonly used a frother, such as pine oil, which serves to increase the spreading of fatty acid at water surfaces, and to produce a froth.

Oleic acid generally makes the most suitable collector for selective non-sulphide flotation, as does xanthate for differential sulphide flotation. Inasmuch as oleic acid is a powerful collector, the separation of non-sulphides is usually attained by the use of depressors rather than activators.

Colloidal substances constitute the most widely known class of depressors. They possess two distinct functions as depressors in flotation: (1) they act as watery surface coatings which prevent the flotation of the mineral particles, and (2) they cause dispersion of the mineral particles by attaching to their surfaces electric charges of like sign. Dispersion prevents the agglomeration of mineral particles, which in turn hinders collecting and weakens the froth. Colloidal substances may act either as uncharged surface coatings or as electrically charged dispersing agents. A wide variety of such substances have recently received attention. They are: metal silicate gels, tannin or tannic acid, metal hydroxide sols, starch, and sodium silicate. These five are given in the order of the persistency with which they disperse.

Metal silicate gels, like other gels and gelatinous precipitate, do not disperse ore pulps, but cause flocculation. Tannic acid was found to disperse but slightly. Metal hydroxide sols are good dispersing agents, but readily change to flocculating agents in the presence of certain electrolytes. Starch disperses when the ore pulp is acid or alkaline, but flocculates when it is neutral. Sodium silicate disperses under all ordinary conditions.

Metal silicate gels[1] are particularly applicable to the depression of quartz, for their action depends on the tendency of the quartz to adsorb the metal, which in turn acts as a bond between the quartz and the depressing hydrous gel. The depression of calcite[2] in ores of fluorspar, barite, and tungsten has been accomplished either with sodium silicate and an acid reagent which probably increases jellying and calcite solubility, thus forming calcium silicate gel on the calcite; or with a heavy metal salt ($CuSO_4$) and sodium silicate, which form in the ore pulp a metal silicate gel which probably becomes adsorbed by the calcite through a tendency toward chemical interchange. In experimenting with gels, I have found the recording of pH essential. From 1.5 lb. to 6 lb. of gel per ton of ore has been used.

Tannin contains colloidal acids, which in certain cases seem to react very selectively with particular ore minerals. By the use of 1.5 lb. of tannic acid per ton of ore, fluorspar was floated from calcite, which probably became coated with colloidal tannic acid.[3] The flotation of manganese oxides from siliceous gangue minerals was improved by the use of 0.25 lb. of tannic acid per ton of ore.[4] Dispersion, or deflocculation of clots of manganese minerals is said to have improved the selectivity of the flotation, although the tannic acid may have reacted with base metals adsorbed by the silicates.

Metal hydroxide sols,[5] in contrast to the familiar gelatinous precipitates, are dispersing agents. An aluminum hydroxide sol was prepared from a gelatinous aluminum hydroxide precipitate by heating the precipitate in water made slightly acid with HCl. Cassiterite ore pulp was deflocculated by this sol. A great variety of metal hydroxide sols may be formed by simple methods; they are very sensitive to the action of dissolved inorganic salts, and may prove valuable as selective depressors in soap flotation. Portland cement probably contains such sols.

Starch is an emulsoid colloid, and is therefore positively charged in an acid medium and negatively charged in an alkaline medium. As the solution changes from acid or alkaline to neutral, the charge also becomes neutral, and the starch flocculates the ore pulp. The dispersing action appears to become more selective as the neutral condition is approached, and if this condition were properly utilized it might prove to be a valuable flotation tool. Starch in amounts of from 0.5 lb. to 2 lb. per ton of ore has been used in dispersing phosphate material in the flotation of quartz from phosphates.[6]

Sodium silicate has had extensive use as a deflocculating or dispersing agent; generally about 0.2 lb. per ton of ore is used, but from 0.1 lb. to 6 lb. have had application. It has been used in the flotation of carbonates, such as calcite and rhodocrosite, oxides such as cassiterite and manganese, fluorite, phosphates, sulphates, and numerous other ore minerals.[7]

The flotation of many non-sulphide ores, such as cassiterite ores, should be preceded by desliming. Usually, it is advantageous to deflocculate the ore pulp before desliming, and this may be accomplished with deflocculating agents such as metal hydroxide sols, starch, or sodium silicate.

[1]Patek, J. M.: *E.&M.J.*, March, 1934. Patek, J. M.: U. S. Patent No. 1,953,431. April, 1934.
[2]U. S. Bureau of Mines R. I. 3239, June, 1934.
[3]Unpublished C. W. A. Report, University of Wisconsin. 1934.
[4]Weinig, A. J.: U. S. Patent No. 1,911,865. 1933.
[5]Applied by J. M. Patek, June, 1934.
[6]Lange, L. H.: U. S. Patent No. 1,914,695. 1933.
[7]A. M. Gaudin: "Flotation." McGraw-Hill Book Company, New York, 1932.

Silicosis Among Granite Quarriers

TO DETERMINE THE EFFECT of granite dust on quarry workers, the United States Public Health Service made a study of the physical condition of men engaged in a representative Vermont quarry. In addition to a clinico-radiographic investigation, the dust exposure for the various occupations was determined. The results are published in Reprint 1628, Public Health Reports. In summary the report states:

"The present report deals with a study of the effects of the inhalation of granite dust generated in granite quarrying. A clinico-radiographic study of 63 granite quarriers was made, in addition to determinations of the occupational dust exposure. The dust determinations showed that 38 per cent of the workers (drillers) were exposed to many times the amount of dust considered safe at the present time. The clinical findings disclosed that drillers were the only persons showing pathologic lung changes. Half of these workers with an exposure of five to nineteen years had silicosis, and four of the five men with more than twenty years of such trade life showed this condition. This study suggests that quarry drillers may experience as high a death rate from pulmonary tuberculosis as do other pneumatic-tool workers in granite-cutting sheds. Methods for the elimination of dust in quarry operations are also presented."

Mine-Hoist Control

Derives Advantages From Time-Limit Acceleration

H. W. Chadbourne

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Schenectady, N. Y.

Engineering opinion now favors this system, as compared with the use of current-limit relays, largely because of its greater simplicity. Additional points are that it is faster on heavy loads; the peak varies directly with the load; and the motor will accelerate any load within its capacity. The relays can be individually adjusted

◆

USE of current-limit relays, with magnetic control, for governing the acceleration of induction-motor-driven mine hoists, has been standard for a number of years. During the past few years time-limit relays have to some extent replaced the first-mentioned type, the principal reason being the greater simplicity of the time-limit system. Dependable relays are available for either system. In the following are shown the operating advantages and disadvantages of each system.

To portray the exact conditions, a specific hoisting problem was taken and the details of the torque-time curves for each resistance step were calculated. Data for the problem were: A vertical shaft; balanced operation; maximum lift, 1,000 ft.; cage, 8,000 lb.; car, 4,000 lb.; load, 8,000 lb.; rope diameter, 1⅛ in.; rope speed, 1,200 ft. per min.; drum, cylindrical type—assumed weight, 45,000 lb.

Calculations were made at normal load, no load, and 33 per cent overload, or 10,600 lb. Fig. 1 shows the three duty cycles. During the acceleration period, which is the part of the cycle of present primary interest, 75 hp. must be added for acceleration of the motor armature. The following tabulation shows the power required under the various conditions:

	No Load	Full Load	Overload
Load.....	150	460	575
Acceleration.....	295	315	325

The RMS heating value of the normal cycle is 350 hp., and therefore a 400-hp. motor would be used.

Fig. 2 shows a typical set of torque-speed curves for an induction motor, with slightly over 250 per cent maximum torque and with an eight-point control having the resistor arranged for mine-hoist service.

From the curves given in Fig. 2, it is possible to read the torque which the motor will develop at any speed and on any step of the resistor. The duty cycles show the torque required for the dead load, and also the torque or horsepower for acceleration, under different loads. Before a torque-speed curve can be calculated it is necessary to plot a series of time-speed curves. These curves are calculated thus: Torque to

$$\text{accelerate} = \frac{WR^2}{308} \text{ r.p.m. } syn. \frac{ds}{dt}$$

$$\text{and } dt = \frac{WR^2}{308} \frac{\text{r.p.m. } syn}{Tm} \frac{(\quad ds \quad)}{(TM - Tf)}$$

where TM = motor torque as a decimal at any speed.

Tf = dead-load torque as a decimal of normal motor torque.

Tm = normal motor torque in lb.-ft.

r.p.m. = motor speed as a decimal of normal.

Referring to Fig. 2, with a dead load of 460 hp., the motor would start on the fourth resistance step. From this curve a time-speed is calculated as given in Table I. Tf = 460 hp. = 1.15 of normal.

The motor would accelerate to about 55 per cent speed on this step. The summation values plotted against the average speed points give a curve as shown in Fig. 3. Curves for the other steps are calculated in a similar manner. This crude method of integration gives the time necessary to accelerate the given WR^2.

Assuming a 400-hp., 600-r.p.m. motor, the WR^2 of its armature is 2,700 ft.-lb. For the mechanical parts, including the load, when changed to motor speed, the values are as follows: No load, 8,000; full load, 8,700; overload, 9,000. Then for the total of armature and load the values become: No load, 10,700; full load, 11,400; overload, 11,900 ft.-lb. Then the factor $\frac{WR^2}{308} \frac{\text{r.p.m. } syn.}{TM}$ becomes for normal load

$$\frac{11.400 \times 600}{308 \times \frac{5{,}250 \times 400}{585}} = 6.15$$

The last column in the tabulation presented in the foregoing multiplied by this factor gives the time in seconds to accelerate.

In calculating a torque-speed curve for any particular resistance step, the curves in Fig. 3 and the factor given are used. The first three accelerating steps are for light loads and slow-speed running. In normal operation the contactors come in sequence requiring about 0.1 sec. each, or 0.3 sec. total.

Similar calculations can be made for the other steps and a curve plotted, as shown in Fig. 4. This curve is based on using current-limit relays with a minimum setting of 150 per cent load, or 600 hp. For purposes of comparison, I assume that time-limit relays can be adjusted to give the same curve. This curve shows the torque of the motor at any time and the time at which the successive contactors close. The speed in feet per second is plotted on the same sheet.

Figs. 5 and 6 show a set of time-speed curves for no load and overload,

Table I—Calculation for Time-Speed Curve

Speed	$TM - Tf$	$\frac{1}{TM - Tf}$	$\frac{ds}{TM - Tf}$	Summation
0.05	2.225 — 1.15 = 1.075	0.93	0.093	0.093
0.15	2.1 — 1.15 = 0.95	1.05	0.105	0.198
0.25	1.9 — 1.15 = 0.75	1.13	0.113	0.311
0.35	1.67 — 1.15 = 0.52	1.92	0.192	0.503
0.45	1.41 — 1.15 = 0.26	3.85	0.385	0.888
0.55	1.16 — 1.15 = 0.01	100.00	10.000	10.888

Table II—Calculations for Curve for Fourth Step

Per Cent Speed	From Curve	Factor	Seconds
0–15	0.14 –0	= 0.14 × 6.15 = 0.865 + 0.3	= 1.65
15–30	0.318–0.14	= 0.178 × 6.15 = 1.09 + 1.165	= 2.255
30–40	0.508–0.318	= 0.19 × 6.15 = 1.17 + 2.255	= 3.425
40–50	0.888–0.508	= 0.38 × 6.15 =, 2.33 +, 3.425	= 5.755

respectively. These are calculated the same as Fig. 3. The factor $\frac{WR^2}{308} \cdot \frac{\text{r.p.m.}}{TM}$ becomes 5.75 for no load and 6.3 for overload. From Figs. 5 and 6, and the factors just given, other torque-time curves are plotted similar to those shown in Fig. 4. The speed-time curve is also plotted on each sheet. Figs. 7 and 8 show the no-load and overload curves, respectively, with current-limit relays, and Figs. 9 and 10 are similar curves, but with time-limit relays. In each case the relays have the same settings as in Fig. 4.

In a comparison of these types of relays the statement is often made that with light loads the motor will accelerate quicker with current limit than with time limit. This is true, but not to the extent popularly supposed. The relays are usually set so that with full load the acceleration curve is a straight line (see speed curve in Fig. 4). Fig. 9, the torque-time curve for no load, with time-limit relays, shows that full speed is reached in 7.55 sec. During this time the cage has traveled 88 ft. Fig. 7, the no-load torque-time curve with current-limit relays, shows that full speed is reached in 4.32 sec. During that time the cage has traveled 46 ft. Taking the difference in time, 3.23 sec., and full speed, 20 ft. per sec., the cage will travel 64.6 ft., or a total of 110.6 ft. Therefore, during 7.55 sec. the cage will travel 110.6 — 88, or 22.6 ft., farther with current limit than it will with time limit. This is a gain of 1.13 sec. per trip.

From Fig. 2

Per Cent Speed	Per Cent Torque	Horsepower Torque
15	210	840
30	178	715
40	153	615
50	128	513

To offset this gain during no-load conditions we must consider the loss due to overload. A comparison of Figs. 8 and 10 shows that with current limit full speed is reached in 12.6 sec. and with a travel of 106.4 ft., whereas with time limit the figures are 8.55 sec. and 72.4 ft. The difference in time, 4.05 sec. at 20 ft. per sec., gives 81 ft. Therefore, with time limit the cage would travel 153 ft. in the first 12.6 sec. and with current limit it would travel only 106.4 ft., or a difference of 46.4 ft., or 2.32 sec. loss.

From the foregoing one sees that, from the standpoint of time, current limit is faster on light loads, but time

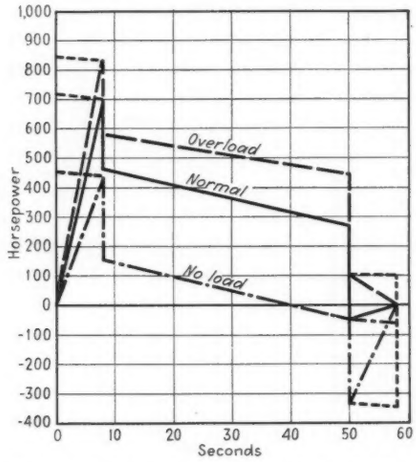


Fig. 1—Three duty cycles—normal load, no load, and 33 per cent overload

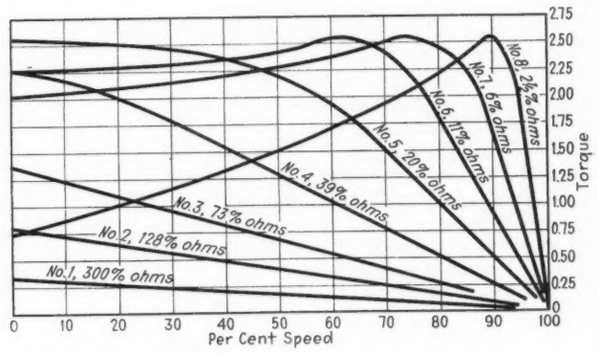


Fig. 2—Speed-Torque curves

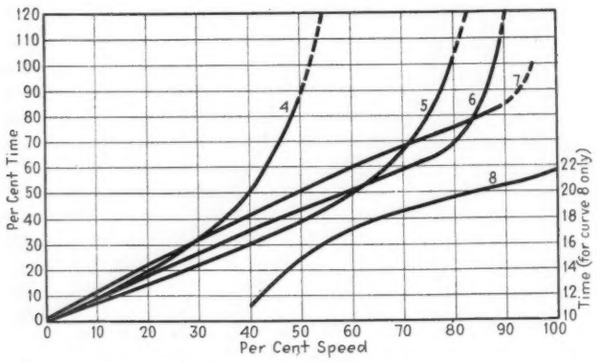


Fig. 3—Time-Speed curves, normal load

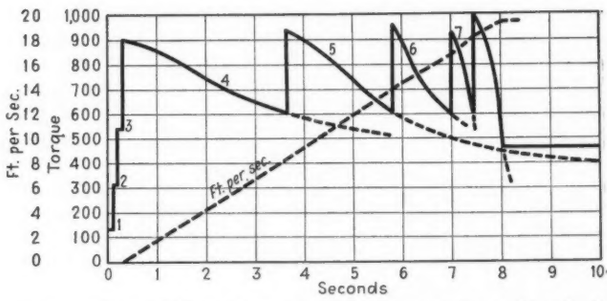


Fig. 4—Torque-Time curve, normal load, current or time limit

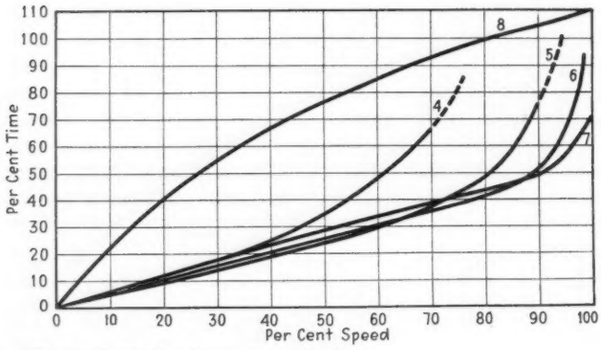


Fig. 5—Time-Speed curves, no load

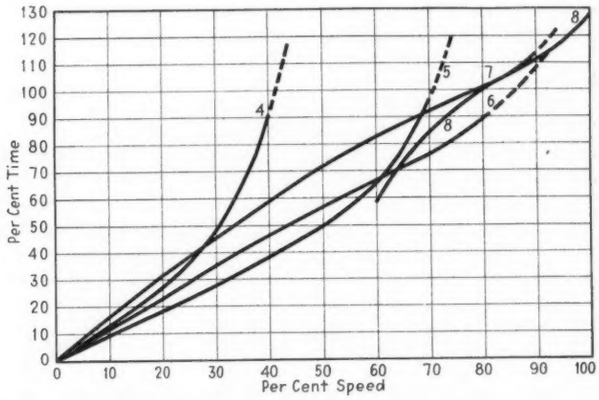


Fig. 6—Time-Speed curves, overload

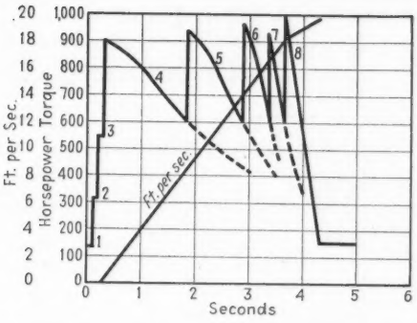


Fig. 7—Torque-Time curve, no load, current limit

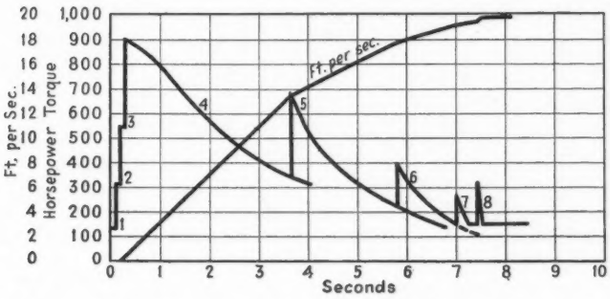


Fig. 9—Torque-Time curve, no load, time limit

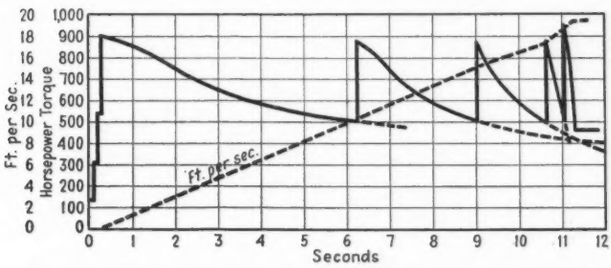


Fig. 11—Torque-Time curve, normal load, current or time limit.

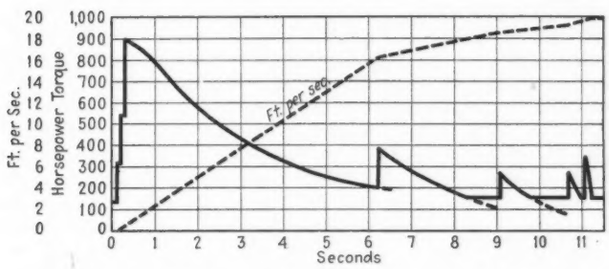


Fig. 13—Torque-Time curve, no load, time limit. Basis different from that of Fig. 9

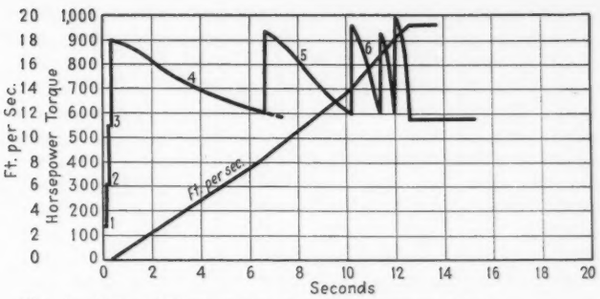


Fig. 8—Torque-Time curve, overload, current limit

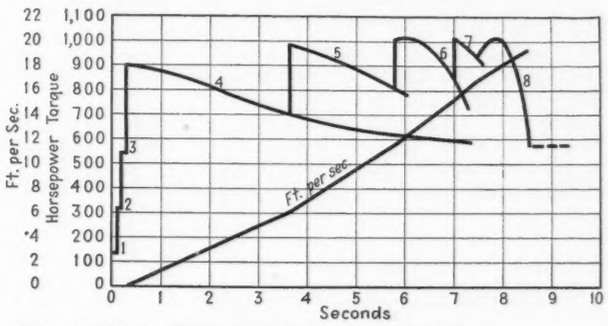


Fig. 10—Torque-Time curve, overload, time limit

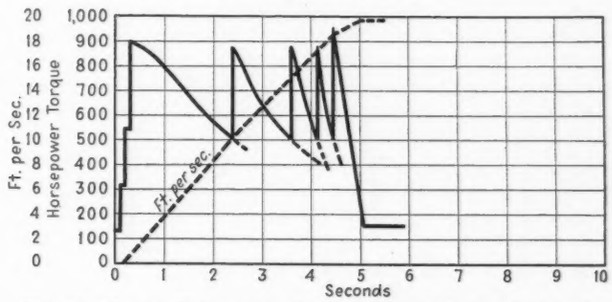


Fig. 12—Torque-Time curve, no load, current limit. Basis different from that of Fig. 7

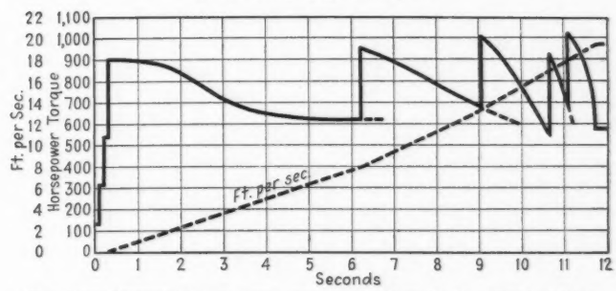


Fig. 14—Torque-Time curve, overload, time limit. Basis different from that of Fig. 10

limit is faster on heavy loads. The amount of time involved is small in either case. The only condition in which the time gained or lost is appreciable is on a short, fast cycle. The reader should note that with current limit the peaks are the same regardless of load. With time limit the peaks vary with the load up to the maximum torque of the motor.

These curves are based on a minimum current-limit setting of 600 hp., or 150 per cent load. This is higher than usual. If a setting of 125 per cent, or 500 hp., is used, somewhat different results are secured. The same torque curves as in Fig. 2 are used; also the speed-time curves of Figs. 3, 5, and 6 and the same factors for time to accelerate—namely, 5.75, 6.15, and 6.3.

With the lower setting of the relays, and therefore lower torque peaks, the time for accelertaion with normal load will be increased from 8 to 11.3 sec. Fig. 11 shows the torque-time curve for normal load with either current- or time-limit relays. Fig. 12 shows the torque-time curve for no-load current limit.

As the dead load during overload is 575 hp., and the current-limit relays are set for 500 hp., the relays will never operate. The curve would be very much like Fig. 8 up to the fourth step. The motor would accelerate up to 44 per cent speed on this step and continue to run at that speed. If a maximum-torque pushbutton were used, the next accelerating contactor would close and the motor would accelerate on the fifth step up to 71 per cent speed, and then continue to run at that speed.

Figs. 13 and 14 show the no-load and overload torque-time curves with time-limit relays. A comparison of Figs. 12 and 13, no load with current limit and time limit, respectively, shows a gain in time of 1.75 sec. with the current-limit control. On the other hand, as shown, it was not possible to accelerate the overload with current-limit control.

The resistor values for each step are chosen so as to give the same torque peak on each step. A glance at Fig. 4 shows this to be true except on the last step. For this step the designing engineers are unable to control the resistance value inasmuch as this depends on the size and length of secondary leads and various other installation factors.

A mine hoist is usually designed for a given load, but must always be capable of operating over a wide range of loads. One must know the maximum load to be hoisted before the setting of current-limit relays can be determined. If this setting is high, the peak loads will always be high. In other words, if the maximum load is high when compared with the normal load, the hoist will always draw abnormally high peak loads during acceleration. The current-limit relays are capable of adjutsment over a wide range of loads.

Summary

Current-limit relays give faster acceleration with light loads; with a given relay setting, the peaks are constant for all loads; the motor cannot accelerate extremely heavy loads unless the relays are given a high setting, and this, in turn, giving high peaks.

Time limit is faster on heavy loads; the peaks vary directly with the load; the motor will accelerate any load within its capacity. Time-limit relays have another advantage in that they can be individually adjusted.

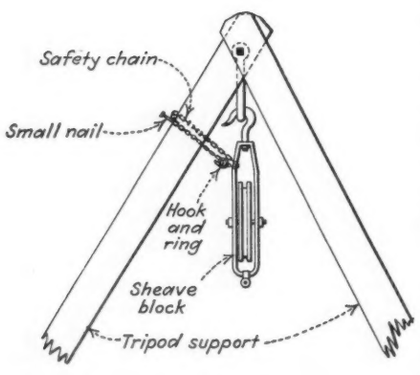
The foregoing characteristics, together with the simplicity of wiring on the panel, have caused a gradual change in engineering opinion in favor of time-limit relays.

Alabama Tin Deposits of Doubtful Value

A SURVEY of tin occurrences in Alabama was made possible by an allotment to the Geological Survey of funds from the Public Works Administration, and the results have been made public in a memorandum of the Department of the Interior—P.W. 20674. The work was done by Elmer W. Ellsworth, who spent four months in the field examining every reported occurrence of tin, either in place or in alluvial deposits, in the State of Alabama. The investigation included the collection and analysis of samples in widely scattered localities in Chilton, Coosa, and Clay counties. Data collected during the investigation indicate that the known tin-bearing deposits have slight if any commercial value.

A few dike-like bodies of pegmatitic quartz and muscovite containing tinstone have been found in Coosa County, Ala. Traces of tin are also found in alluvial deposits in Coosa and Clay counties. The tin occurs as the mineral cassiterite, and in the pegmatitic dikes it is irregularly distributed in the more highly fractured, micaceous portions of the quartz body. The dike-like masses are irregular along both their strike and dip, usually ranging in width from a foot or less to 1 or 2 in., and there is so far no indication that large orebodies of workable grade exist in the region. The present study has revealed traces of tin in alluvial deposits scattered over a rather wide area, and although these data are of scientific interest, the deposits cannot at present be considered commercially workable for their content of tin. In conclusion, it can be stated that the deposits of tin examined do not appear to contain sufficient tin to warrant commercial exploitation. Whether prospecting for tin in Alabama in the future will reveal workable tin deposits is altogether problematic.

Beware the Sheave Block

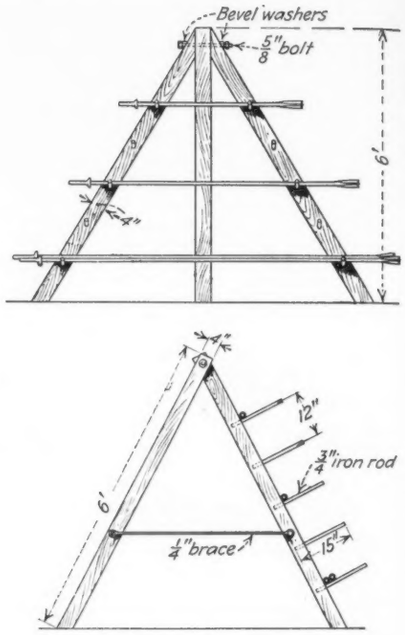


WHEN an overhead sheave block breaks loose from its moorings it seldom gives any advance warning, writes Roy H. Poston, Flat River, Mo.

In the device shown in the sketch, a short piece of chain will deflect the course of the falling sheave block and its load to one side, and, in the case of tripod mounting, will guide the loaded sheave along the tripod leg to the ground. Use of the device with surface diamond-drill equipment at a mine in the Southeast Missouri lead district undoubtedly saved two workmen from serious or possibly fatal injury on one occasion, when the sheave block hook broke during the hoisting of a load of drill rods.

A Rack for Storing Steel

THE common practice of storing sharpened drill steel in bins or in piles on the blacksmith shop floor may be profitably altered by the construction of the simple tripod drill-steel rack shown in the accompanying sketch, writes Evan W. Baker, master mechanic at the Bunker Hill mine, Sombrero Butte, Ariz. Such a rack makes possible a rapid selection of desired lengths by miner or nipper.

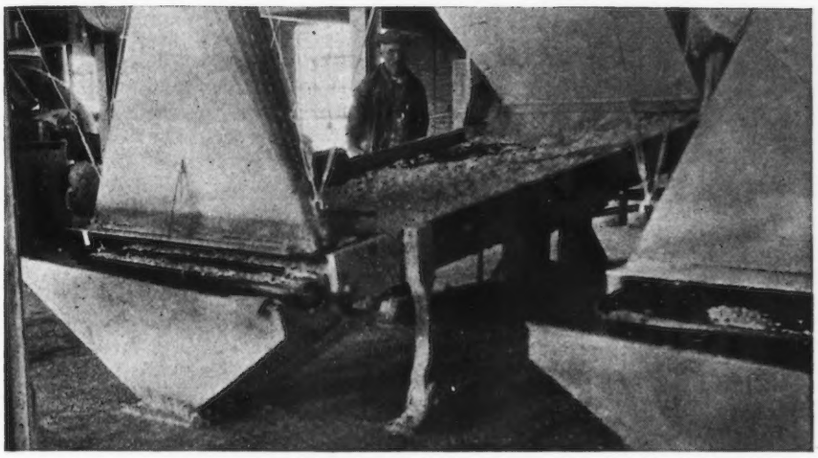


The tripod is constructed of three 4x 4-in. posts 6 ft. long. On one end of each outer post is cut sufficient bevel to give the proper spread, at the base, when the rack is set upright. This spread should be about one foot less than the longest steel to be held. After the bevels are cut, the pieces are laid in position and bored at the apex for a $\frac{5}{8}$-in. bolt, which is then inserted, and the nut screwed loosely on. Five holes, of $\frac{3}{4}$-in. diameter, are then bored in each of the outer posts. These holes should be spaced 1 ft. apart and bored to a depth of 3 in. Iron rods $\frac{3}{4}$x15-in. are then driven into these holes.

When completed the rack is placed upright, and the center leg or post is swung back a distance of 3 or 4 ft. Shallow depressions cut in a dirt floor serve to keep the legs of the rack from slipping. In the instance of a concrete floor, braces of $\frac{1}{4}$-in. rod, shown in the sketch, should be employed.

The drill steel may then be laid neatly across the $\frac{3}{4}$-in. rods, starters being placed on the top of the rack, whereas the longer steel is at the bottom. The bevel washers shown in the sketch may be used but are not necessary.

Processing Canadian Asbestos



A shaking screen cleaning asbestos fiber in one of the mills of Asbestos Corporation, Limited, at Thetford Mines, Quebec

J. G. Ross

Manager, Asbestos Corporation Limited, Thetford Mines, Quebec, Canada

Market preparation at Thetford Mines depends on characteristics of the fiber and individual requirements of manufacturers . . . Close mill-control system employed involves use of special screen-testing equipment

PREPARATION of chrysotile asbestos fiber for the market, as practiced by Asbestos Corporation Limited, Thetford Mines, Quebec, Canada, is governed by the purpose for which the fiber is to be used. Consideration is given not only to the general uses for which length of fiber is a requisite but also to the individual requirements of the manufacturer and the particular process in which the fiber is to be ultimately finished.

Grades of asbestos fiber are broadly divided into seven classifications or groups by Canadian producers. Groups 1 and 2 are designated "crudes." These are long fibers recovered by hand-cobbing and are not milled. They are separated into two grades: No. 1 Crude, consisting of fibers $\frac{3}{4}$ in. in length and longer, and No. 2 Crude, consisting of fibers $\frac{3}{8}$ to $\frac{3}{4}$ in. in length. In preparing these, the rough cobbed crude is dried on steam pipes and the fiber is freed from adhering particles of rock by hammering. The fibers are sorted into lengths by the cobbers, cleaned by screening, and bagged in jute bags, each holding 100 lb. Crude fibers are used in spinning the finest and highest-grade yarns. Yarns as fine as No. 80 are spun from Canadian asbestos. The finer yarns, especially those low in magnetic iron, are woven into tapes for electrical insulation.

Groups 3 to 7, inclusive, are all recovered by means of mechanical treatment in the modern mills. Rock containing veins of fiber not easily recoverable by means of hand-cobbing is sent to the mill, where the fiber is separated from the rock, cleaned, and graded according to length.

Group 3 includes the long fibers which are used for spinning yarns, for cloth, automobile brake lining, and industrial equipment, as well as for high-pressure magnesia insulation and high-grade compressed sheet for steam packing or jointing.

Group 4 consists of medium length fibers which are principally employed in the manufacture of asbestos shingles, plain and corrugated asbestos sheets, and asbestos pipe. Well-opened fibers in Group 4 are required to make high-grade board, which, in turn, is used in the manufacture of compressed and flexible brake lining and clutch facings.

The fibers in Groups 5 and 6 are used in the manufacture of asbestos board and paper.

Group 7 fibers may be combined with those of Groups 5 and 6 in making board, paper, or gaskets, or they may be mixed with asphaltic compounds for use in roofing putties and calking compounds, and cements.

Groups and grades are determined by a screening test, the method now adopted throughout the world having

Subdivision of the Grades Of Milled Asbestos

The minimum test at which each grade is shipped as specified in the Canadian Standard Classification system is as follows:

Group No. 3—Spinning or Textile Fiber

Consists of fiber testing 0–8–6–2 and over

Standard Designation of Grades	Guaranteed Minimum Shipping Test
3-D	8.0– 6.0–1.0–1.0
3-F	7.0– 7.0–1.5–0.5
3-K	4.0– 7.0–4.0–1.0
3-M	2.0– 9.0–4.0–1.0
3-R	2.0– 8.0–4.0–2.0
3-T	1.0– 9.0–4.0–2.0
3-W	0.0–10.0–4.0–2.0
3-Z	0.0– 8.0–6.0–2.0

Group No. 4—Shingle Fiber

Consists of fiber testing below 0–8–6–2 and including 0.0–1.5–9.5–5.0

4-D	0.0–5.0–10.0–1.0
4-F	0.0–3.0–12.0–1.0
4-H	0.0–5.0– 8.0–3.0
4-K	0.0–4.0– 9.0–3.0
4-L	0.0–3.0–10.0–3.0
4-M	0.0–4.0– 8.0–4.0
4-R	0.0–3.0– 9.0–4.0
4-T	0.0–2.0–10.0–4.0
4-Z	0.0–1.5– 9.5–5.0

Group No. 5—Paper Fiber

Consists of fiber testing below 0.0–1.5–9.5–5.0 to and including 0–0–8–8–

5-D	0.0–0.5–10.5–5.0
5-F	0.0–0.0–13.0–3.0
5-K	0.0–0.0–12.0–4.0
5-M	0.0–0.0–11.0–5.0
5-R	0.0–0.0–10.0–6.0
5-T	0.0–0.0– 9.0–7.0
5-Z	0.0–0.0– 8.0–8.0

Group No. 6—Waste, Stucco, or Plaster

Consists of material testing below 0–0–8–8– and above 0–0–5–11

Group No. 7—Refuse or Shorts

Consists of material testing 0–0–5–11 and below

6-D	0.0–0.0–7.0– 9.0
7-D	0.0–0.0–5.0–11.0
7-F	0.0–0.0–4.0–12.0
7-H	0.0–0.0–3.0–13.0
7-K	0.0–0.0–2.0–14.0
7-M	0.0–0.0–1.0–15.0
7-R	0.0–0.0–0.0–16.0
7-T	0.0–0.0–0.0–16.0

been developed at the mills in Thetford Mines, Que. The system of controlling the grades of fiber as produced in the mills and of determining the test on shipment is by a mechanically operated set of screens, described as follows:

The machine consists of a nest of four wooden boxes, measuring 24½ by 14¾ in. and 3½ in. in depth. These boxes, which are superposed one above the other, are numbered from the top down 1, 2, 3, 4. The bottoms of boxes Nos. 1, 2, and 3 are made of metallic screen of the following specifications: Box No. 1: ½-in. opening, diameter of wire, 0.105 in. Box No. 2: 4-mesh wire, 0.063 in. Box No. 3: 10-mesh wire, 0.047 in. Box No. 4 is a receptacle for the fines which fall through the three other boxes. The nest of four boxes or trays rests on a table to which an eccentric with a throw of $\frac{35}{32}$ in. gives a movement of 1$\frac{9}{16}$-in. travel.

To make a test, 16 oz. of asbestos is put on the top tray, which is covered. The machine is run at the rate of 300 r.p.m. at the shaft of the eccentric, and, by means of an automatic device, it is kept in operation for exactly two minutes, giving the nest a horizontal shaking movement. At the end of this time, the asbestos that remains on each tray is weighed. This gives the grades of the asbestos fiber. The longest fiber naturally stays on the top tray, whereas the shorter fiber, according to its length, remains on screens 2 and 3 or drops into the pan or lowest tray. The more fiber retained on the first screen and the less fiber in the pan, the higher the grade and therefore the greater its value.

All fibers in a given grade are not

Asbestos veins in a face on the 500-ft. level of the King mine. This mine has been in continuous operation for 56 years

of a definite length. For example, a spinning fiber, in which the valuable part is that contained on the first two screens, also contains fibers which on test will pass the second and even the third screen. A typical spinning grade tests 4-7-4-1; that is, 4 oz. on the first screen, with ½-in. opening; 7 oz. on the second, or 4-mesh screen; 4 oz. on the third, or 10-mesh screen; and 1 oz. in the pan, or through the 10-mesh screen. Similarly, a paper stock may test 0-0-10-6; that is, all the fiber passes the 4-mesh screen, 10 oz. is retained on the 10-mesh, while 6 oz. pass through the 10-mesh screen.

Mill production, particularly on short fibers, is sometimes controlled on a nest of fine-mesh screens in a Ro-tap or similar testing machine.

The most important feature in an asbestos fiber, other than strength, fineness, and flexibility, is cleanliness. Foreign objects or materials are detrimental both in further processing and in the finished article. Pieces of wood from track ties or lumber used in open-pit mining may damage the cards used in processing spinning fiber. Wood may form lumps in shingles, sheets, gaskets, or clutch facings. Oil from equipment, such as cranes, shovels, or locomotives, may cause spots on polished sheets to which paint or other finishing material will not adhere. Mica or spicules of picrolite may cause spots on sheets and boards. Sand or fine rock contained in any fiber must be eliminated by the manufacturer, thus causing him a loss in tonnage.

Mining and Milling Operations Must Be Co-ordinated

To insure clean fiber of maximum strength, the proper method of mining and milling must be employed. The mining method is governed by the size of the orebody and its location. The flowsheet of the mill must be adapted to the hardness of the rock, ease with which the fiber separates from the rock, and grades for which the particular fiber is most suitable.

In open-pit mining, only with difficulty can the fiber be kept free from contamination and discoloration by earth from the overburden brought down by rainstorms, from mica coming from weathered granitic intrusions, from cinders and oil from pit equipment, and from particles of wood from track ties and lumber. In the block-caving system of mining all of these difficulties are avoided. The ore is gradually broken down by pressure and much of the fiber is released by the slowly moving rock.

Rock before going to the primary crushers is carefully hand-picked on a traveling belt, for tramp iron and other foreign materials. The rock must be broken to pieces of less than 3 in. in size for efficient drying. The less crushing that is done the less the fiber is cut, bruised, and weakened. Well-broken rock from the mine requires a lesser amount of crushing than from open-pit operations.

Asbestos fiber bagged for shipment in the storehouse at the King mine

In drying, the loose fiber should be exposed to heat for as short a period as possible and not at all to a flame. Excess heat may drive out a portion of the water of crystallization and lessen the strength of the filaments. When drying is done in a revolving dryer, some fiber is liberated by the ball-mill action, but at the same time the fiber may be bruised and cut, lowering the proportion recovered in the longer grades.

Milling of asbestos-bearing rock is comparatively simple. The rock is reduced in size by successive crushings. After each breaking the fine rock is eliminated by screening and the fiber aspirated, the overs from the screens passing to the next crushing operation. The fiber is then taken to graders fitted with perforated plates; in these, beaters open the bundles of fiber into fluffy masses, drive out fine dust, and divide the fiber into grades. Successive divisions by grading depend on uses to which the fiber is to be put and vary not only in length but in openness or harshness. One manufacturer may require a grade of fiber of uniform length which, however, will test the same as one made up of a mixture of comparatively long and short fibers. After grading, each lot is screened to eliminate small rock particles released by the beaters in grading.

Grades vary according to requirements of processes and countries. Three quite different types of fiber are called for in the manufacture of shingles in the United States, Europe, and Japan, although the finishing processes vary but little. Specifications in different countries also require variations in grades.

In the Canadian field, five distinct types of fiber occur, each peculiarly adapted for specific uses, and each requiring an individual method of milling to prepare it for the market. Although Thetford fiber can be used for practically all purposes to which a chrysotile fiber can be applied, it is of the highest value in the crude form, in spinning and paper grades, and in the short grades for lubrication.

Black Lake fiber is somewhat harsher and, although it is a good spinning fiber for brake lining, it is eminently suitable for use in the manufacture of shingles, sheets and pipes. Fiber from Vimy Ridge is competitive with the best foreign fibers for shingles, sheets, and pipes, and is excellent for compressed sheets. Vimy short grades are employed in the manufacture of cold-moulded products used in the electrical industry. At East Broughton is produced a soft fiber excellent for the cement stocks used in insulation. Types from the various parts of the field differ to such a degree that a grade from one district may command double the price of a grade of similar test from another mine. In the mill, each grade is controlled by tests every half hour, the fiber is again tested as bagged, and finally before shipment a test is made by an inspector.

During the past few years advances have been made in producing fibers of uniform test, clean, and each adapted for its own use. At least 2,500 different articles in which asbestos is the main constituent are listed in manufacturers' catalogs. With improvement in products from the mill, and the reliability of grades as now standardized, the use of asbestos is increasing. Manufacturers' requirements are studied, and fiber is supplied to them in such form that they will get the maximum value out of it.

Grade Markings Standardized to Avoid Confusion

Milled fiber is usually packed in 8-oz. jute bags by hand or by packing machines. Bags contain 100 or 125 lb. when filled by machine and 100 lb. when filled by hand. Bags vary in size for different grades. Most grades are packed in bags measuring 26x40 in., although more than twenty different sizes of bags are in use. Bags are printed with the name of the producing company, its brand, and the standard designation of the grade they contain. The printing on bags for each group is of a distinctive color. In the past considerable confusion has arisen owing to the irregularity of marks designating the various grades, but gradually private marks are being discarded and replaced by standard markings according to government gradings. Experiments are being made in the use of paper bags to endeavor to mitigate the dust nuisance in handling jute bags, particularly in the shorter grades.

NEWS OF THE INDUSTRY

Mining of Gold-Silver Deposits Attractive to Capital

Three Philippine Companies Declare Dividends—Natomas Company Reports Satisfactory Progress in Constructing New $400,000 Dredge in California—RFC Loans Interest Comstock Operators

OUTSTANDING among the influences currently affecting the mining industry in the United States and its possessions is the apparent satisfactory availability of capital for the financing of gold-silver operations. Dividends are also reflecting the improved status of the precious-metal companies. Notable in this respect are the recent dividend announcements of three Philippine producers; namely, Benguet Consolidated, Balatoc Mining, and Baguio Gold Mining. In California, dredging, lode, and placer operations are on the increase, and new construction providing for additional output is seen in practically every mining area of the State. The revival of mining along the Comstock Lode in Nevada is assuming impressive proportions, and further applications for RFC loans to finance the mining of the deposits there are predicted. Elsewhere throughout the country, wherever precious-metal mining has been in progress in recent years, activity is generally reported to be more pronounced than at any time during the past year. The prospect of cheaper power from near-by government-financed hydro-electric projects is said to be stimulating interest in a number of districts.

A summary follows of the more important news events in the various mining areas during the past month.

Philippines

Third-quarter dividends amounting to 2,500,000 pesos were authorized by the directors of Benguet Consolidated and Balatoc Mining. The dividends amount to 0.75 peso per share for Benguet and 0.50 peso per share for Balatoc. The two companies have paid to their shareholders a total of 6,500,000 pesos this year, as compared with 4,200,000 pesos for the same period of last year, an increase of 2,300,000 pesos.

A 10 per cent dividend, the first to be paid by the company, has been declared by directors of the Baguio Gold Mining; it will involve 130,000 pesos. The company has been in active operation for one year.

Work on a 7,000-ft. drain tunnel at the Balatoc mine is well under way and will be completed by Jan. 1. The tunnel will connect with a shaft driven at the mine site and will insure delivery of 700 tons of ore every ten hours from mine to mill, besides draining the upper mine levels.

A 100-ton cyanide plant is nearing completion at the Demonstration Mines, and R. L. Lile, general superintendent, predicts that ore will be running through the mill by Jan. 1.

California

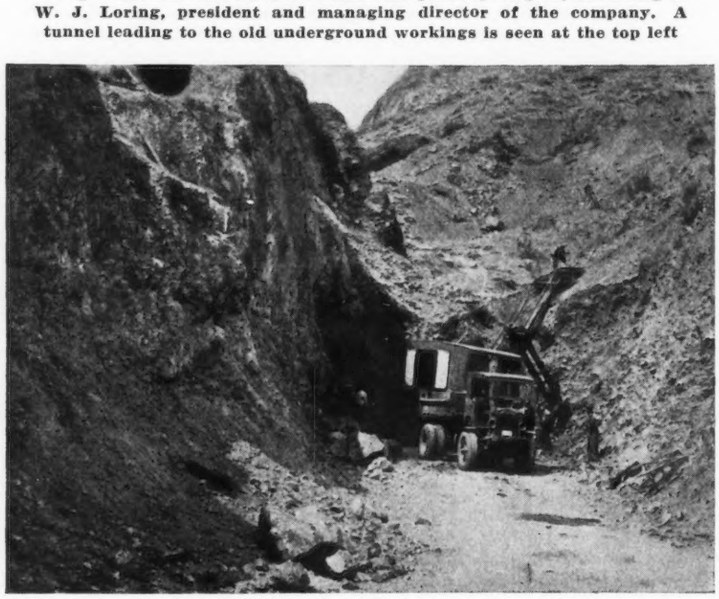
Work is progressing satisfactorily on the new 16-cu.yd. gold placer dredge under construction by the Natomas Company in the Folsom district. The dredge represents an investment of about $400,000, and is to be commissioned in the Salsbury area, south of Folsom Road between Mills and Alder Creek, about four months hence. R. G. Smith is superintendent of dredging operations.

Northern California Mines, operating at Red Hill, near Junction City, has three 6-in. hydraulic giants in operation in the John Day pit, and two of like size on the river pit, with sufficient water to run them sixteen hours a day. The 37 men employed by the company work in three shifts.

Abacada Mining, according to reports from Redding, is preparing to reopen the old Gladstone mine, one-time leading producer in the French Gulch area, and plans early installation of mining machinery and extensive development work. The company also operates the American mine, in the same locality, and is milling about 60 tons of ore a day in the flotation plant built recently.

Operations have been resumed at Canyon Placers, near Dedrick, Trinity County, with fifteen men engaged in enlarging the water reservoir and laying a pipe line. The company expects to hydraulic at the Clark-Dannenbrink mine during the winter. H. G. Kenworthy is general manager.

A power shovel cuts across the outcrop of the Comstock Lode on the Hale & Norcross property of the Arizona Comstock Corporation, near Virginia City, Nev. About 75 per cent of the material broken in the open cut has contained a substantial quantity of gold, according to W. J. Loring, president and managing director of the company. A tunnel leading to the old underground workings is seen at the top left



Lava Cap Gold Mining, operating the Central and Banner mines, near Nevada City, has stepped up production and is milling about 250 tons of ore a day. Work on the tunnel, which will connect the two properties on the 800 level, is progressing according to schedule. Operations are directed by Otto E. Schiffner, general manager.

Two new mills have been placed in operation in the Grass Valley sector. Empress Mining has started milling at its new 200-ton flotation plant in the Newtown district, and Idaho Maryland has commissioned a new 300-ton mill unit, consisting of a 1,000-ton storage bin and grinding and classifying equipment. Mattie Gold Mining, operating the Alcalde mine, in the Deadman's Flat area, reports the discovery of a 3-ft. vein on the 600-ft. level.

Canyon Creek Dredging has enlarged the capacity of its gold placer dredge, operating in Canyon Creek, below Georgetown, and is preparing to work deeper deposits. The bucket line has been lengthened to dig to a depth of 26 ft., the hull extended 8 ft. at the bow, and the bow gantry raised 6 ft. The dredge handles about 50,000 cu.yd. of gravel a month. Thomas Nicholls is in charge of operations.

The cyaniding plant on the 2,500,000-ton Yellow Aster tailing dump, formerly operated by Randsburg Aster Gold Mining, was recently taken over by Anglo American Mining. The firm of Hamilton, Beauchamp and Wordsworth have been retained as consultants to assist in the designing of a new plant. Alfred B. Sabin is in active charge of the operations.

Sinking of a five-compartment shaft at the Walker mine of International Smelting, Plumas County, has been started near the center of the five orebodies opened up by the main tunnel. Plans provide for the sinking of this shaft to an ultimate depth of 2,000 ft., if developments justify such action. Work will be carried on at a rate of 100 ft. a month by the crew maintained at the mine to keep the property in condition. The shaft station has been cut, and the hoisting plant, purchased from Engles Copper last year, has been installed.

Wyoming

Mines in the Atlantic City and South Pass area, 40 miles northeast of Rock Springs, are preparing to continue work throughout the winter. Standard Mining & Milling, operating in the South Pass district, has put up a winter camp and laid in a supply of fuel oil for power requirements. Reports state that ore carrying a substantial amount of gold has been developed on three levels of the mine.

At Atlantic City, the E. T. Fisher company, which has been washing gold three shifts a day, plans to keep machinery stripping ground when the water freezes up. A. F. Baumhoff, of Warren, Idaho, is general manager.

Jay Hill Placers, at Holmes, which has been operating a dragline on Douglas Creek, plans to install other equipment next spring. Suction gravel pumps may be used, according to C. T. Chenevert, secretary-treasurer, if tests prove this equipment practicable.

Minnesota

With iron ore shipments about completed, the records show a slightly better season than last year. In 1933 shipments from the Lake Superior region to Nov. 1 were 20,842,083 tons, whereas this year 21,765,409 tons were shipped. The weather remained ideal for fall ore washing, and all the washing plants completed their quota before freezing started. Some changes took place this year in the number of ore-washing plants on the Mesabi range. Of the fourteen operating this season, two completed their pits and were dismantled. The Drew plant of Cleveland-Cliffs Iron, at Buhl, and the Margaret plant of Butler Bros., also at Buhl, were dismantled. The old Lamberton mine drying plant was also dismantled. The St. Paul washing plant at Keewatin is the only new plant built this year, unless the roasting plant built at the Harrison mine of Butler Bros. for experimental purposes is included. Repairs to the plants for next season's operations have started.

Arizona

What is reported to be one of the most promising gold districts in Arizona lies in a belt extending from Wickenburg, Maricopa County, to Salome, Yuma County. At the eastern end of this 40-mile strip is the famous Vulture mine. Discovered in 1863, the property produced $7,000,000 until the vein was lost at a fault in 1917. Present exploration has not revealed the high-grade orebody, but low-grade ore has been milled for the last three years. West of the Vulture is the new Sunrise mine, brought into production March 1, 1934. Picture rock encountered on the 300 level will be shipped direct to the smelter. Some sulphide ore occurs at a depth of 350 ft. A 75-ton mill is being designed by the Pratt-Gilbert company, of Phoenix. Another new mine is the Pump, which is being developed. The shaft is down 250 ft. in free-milling ore; a stamp mill has been constructed. One of the three veins has been traced 4,500 ft. along the strike. Farther west, the Alaskan mine has developed a good grade of ore for the new flotation mill. Hidden Treasure is another newly discovered mine. Hercules, San Marcos, Socorro, Golden Eagle, and Bonanza mines, in the Harquahala district, all discovered prior to 1909, lie at the western end of the belt. Numerous claims are being worked by prospectors or are under bond and lease, such as the group comprising the Morning Star, Sunny Slope, Harley View, and Best Bet, recently acquired by R. W. Ross.

Boriana Mining, at Yucca, 70 miles south of Kingman, has completed an extensive development program designed to increase production of tungsten concentrate materially above the nine carloads shipped during first ten months of 1934. Underground work included several hundred feet of raises and winzes, 1,000 ft. of drifts, 1,600 ft. of 16-lb. track to replace 12-lb. rails on the main haulage level, a 20x28x56-ft. station for sinking another winze, and considerable retimbering. Surface additions were a 270-hp. diesel engine and generator, a compressor and receiver, an electric hoist, a machine shop, storage tanks, and mill improvements, such as standby equipment for the rolls, a new thickener, a flotation unit, and a filter. A. J. Klant, general superintendent, directed the work, with Walter Hughes in charge of changes in the mine and W. H. Munds, at the mill.

Stoney and Crane, lessors on the Tom Reed, Oatman, have erected a 60-ft., headframe and installed a hoisting engine. Ruth shaft of Ruth-Rattan group is being sunk below the 400 level while regular shipments are maintained to the Reed mill. Several new tanks have been added to increase capacity of the Reed mill to 250 tons per day. The main Reed shaft is to be timbered from the 200 to the 500 level, with further sinking planned.

One hundred tons of 1.5 per cent molybdenum ore per day are being treated by the Arizona Molybdenum Corporation at Copper Creek. Flotation concentrate averaging 97 per cent molybdenum sulphide is reported to be shipped direct to Japan and Europe.

Utah

New equipment has been installed at the Park City Consolidated Mining property at Park City. The company is using successfully a new Eimco-Finley mechanical mucker in the East Crescent fissure, and on the surface a new Ingersoll-Rand compressor supplying 640 cu.ft. per minute has been installed in a fireproof structure. This compressor is being used in conjunction with the old compressor having a capacity of 670 cu.ft. per minute. On the 400 level, a Mancha "Little Trammer" storage-battery locomotive has been installed, and the company is preparing to install in its main shaft a double-deck cage. In the East Crescent winze, a new 75-hp. Westinghouse electrical hoist was been installed. Production of the property, according to General Manager J. J. Beeson, is averaging 200 tons daily.

Operations at New Park Mining, in the East Park City district, are being centered on driving a crosscut from the Mayflower tunnel at a point 4,000 ft.

from the portal toward the downward extension of the old Park Bingham deposit.

Production at the Yankee property of American Smelting & Refining in Mary Ellen gulch, American Fork mining district, is averaging about 600 tons monthly of high-grade gold ore. S. S. Steir, engineer, who is in charge, plans to keep the property open until the first of the year. If winter weather is too severe, the mine will be shut down until spring.

The new orebody on the 900 level of the Eureka Lilly of the Chief Consolidated Mining Company has, according to Cecil Fitch, general manager, every mark of being a major development in the East Tintic (Utah) district. Since being opened about six weeks ago, the deposit has been developed for a length of 500 ft. A winze, at a depth of 20 ft. below the 900 level, exposed ore 20 ft. wide, and a raise 20 ft. above disclosed ore 7 ft. wide. Production is averaging about two carloads daily.

At the Apex Standard, Chief Consolidated Mining is developing ore on the 1,100 level northwest of the shaft, which has been sunk to the 1,200 level. On the 1,000, a winze is being sunk on an ore showing.

Operations have been resumed in the West Toledo mine, at Alta. Development, according to O. A. Jacobson, manager, will consist of prospecting for the continuation of the fissure in the Columbus-Rexall mine.

Kent Keyes, Bert Durrant, and William Peterson are operating the Emma property, in the Fish Springs district in Juab County. Ore is being hauled 90 miles by truck to the International smelter at Tooele. The ore is being taken from a fissure at the bottom of a 300-ft. incline shaft.

H. W. Balsley, of Moab, plans to ship a carload of carnotite ore each month from Dry Valley, in Grand County, to Pittsburgh, Pa.

Idaho

Diamond drilling at the Sunshine mine, near Kellogg, has established the existence of ore at 900 ft. below the 2,100-ft. level, according to a report issued recently by the Sunshine company. "Drilling," states the report, "proved the existence of a shear zone in the Wallace formation to a depth of 3,300 ft. vertically below the adit tunnel level, as well as proving the existence of the Sunshine vein to the 3,000-ft. level."

Polaris Development & Mining, according to Hecla Mining, has secured rights for the development of its property, near Kellogg, through the tunnel of Silver Summit Mining. To reach the Polaris vein will require an extension of a drift from the present westerly face to the Polaris working of about 4,800 ft. The arrangement made with Silver Summit Mining provides for extending the drift westerly in the footwall of the Silver Summit vein, with a crosscut to be driven to the vein every 400 ft.

According to Boise reports, Henry C. Carlisle, consulting engineer, of San Francisco, has acquired a half interest in the Gold Hill & Iowa mine, at Quartzburg, controlled by Talache Mines. The property is credited with a production of $7,000,000 in gold. Present plans for operating the property include installation of larger hoisting and compressor equipment at the 1,100-ft. shaft and erection of a 100-ton amalgamation mill. Operations are scheduled to begin about a month hence.

Montana

Fairview Syndicate, headed by C. M. Roos, which is operating the Fairview mine, on Wisconsin Creek, 6½ miles from Sheridan, Madison County, has opened a substantial vein of gold-silver ore, which was found on a fault at the top of a raise where former operators stopped work.

Properties active in the Basin district include the Morning Glory, on Cataract Creek, which encountered high-grade silver ore in sinking its main shaft; and Basin Goldfields, which shipped 65 tons of high-grade gold ore recently.

Glengarry Mining is developing a gold property near Cooke, in the New World mining district. Construction of a flotation plant was completed recently.

Nevada

Surveys are being made of old mines on and near Lander Hill, at Austin, center of the early-day Reese River silver rush. Several of the principal mines, at one time the country's largest producers of silver, have been acquired by Austin Silver Mining, of which R. M. Atwater, of New York, is president. Old mine workings are to be reopened under the direction of F. Sommer Schmitt, resident manager.

Long-abandoned lease workings on properties of Goldfield Consolidated Mines that were productive some years ago are being reopened by a leasing syndicate of Eastern men, most of them residents of Connecticut. Jack Harris, manager, has installed hoisting equipment at several old shafts and has shipped some ore to Utah smelters. Another group, mostly Los Angeles men, is completing construction of a 50-ton custom mill, with plates, concentrating tables, and flotation cells, near the base of Columbia Mountain in the northern part of the Goldfield district.

An orebody of much promise is being developed on two levels above a depth of 200 ft. in ground of Nevada Gold, in the Stateline district, near the California line and adjoining the Stateline mine, promoted in England some 40 years ago by the notorious Whitaker Wright. A mill, which never crushed any ore, was built at the mine, and a special train from New York brought a load of the dupes of Wright, who took cyanide and died in court during his trial for fraud.

Several tailing-treatment projects of major scale are in operation or planned in Nevada. Bradshaw, Inc., is treating 1,400 tons per day of impounded tailing from the 100-stamp Goldfield Consolidated Mines cyanide mill. A 1,000-ton leaching plant is treating sand tailing from the old Tonopah Mining mill, at Millers, 15 miles west of Tonopah, and a slime-treatment unit is to be added at a cost of about $80,000, according to officers of General Metals Recovery, composed of San Francisco men. Albert Silver, Tonopah metallurgist, is in charge at Millers. Similar projects are being considered to treat tailing from old mills at Seven Troughs and at Fairview.

A 50-ton cyanide mill has started crushing ore from the Ramsey-Comstock mine of Lahontan Mines, at Ramsey, in the Flowery range, about 15 miles east of the Comstock. New orebodies are said to have been opened below the 500-ft. level. A short distance to the east a wide body of gold ore of mill grade has been developed in the Talapoosa mine, which has also produced a substantial tonnage of shipping ore from workings east of the "dike" orebody.

Activity in the Pioche district has been stimulated by the prospect of obtaining low-cost power in the future from Boulder dam. Announcement is made that David B. Gemmill and associates have disposed of the controlling interest in Prince Consolidated Mining to Combined Metals Reduction and International Smelting. The new Prince Consolidated board, reports stated, will include J. O. Elton, manager for International, and E. H. Snyder, president of Combined Metals. Intimations were that, with Boulder power available, plant construction may include an electric zinc plant, a concentrator, and lead smelter.

Capacity of the lately completed flotation mill of Stone Cabin Consolidated, in the Como district, has been increased to 300 tons per day, and a 300-ton cyanide leaching plant, designed to treat the flotation tailing, will soon be completed. F. W. Royer, advisory engineer, estimates the reserve at something over 600,000 tons above the winze level, at about 200 ft. vertical depth. On this level the vein at one point is 207 ft. wide. W. W. Charles, president, with Conrad F. Clothier, Jr., and G. C. Snyman, directors, all from Philadelphia, were at the mine recently.

At the Silver City end of the Comstock district seven mills are crushing ore and two are being enlarged. Working in the 1,300-ft. Colquhoun tunnel, Divide Extension Consolidated has ex-

posed high-grade ore at three points and is treating its product in a 40-ton Lane mill, equipped with plates, amalgamating trap, and vibrating tables. In the Spring Valley mine, a crosscut on the 200-ft. level is near the vein which, on the 100-ft. level, H. B. Bulmer, manager, reports, has a width of 25 ft. of high-grade gold ore. Ore from a long shoot opened in the Emma Nevada mine, south of the Colquhoun, is being run at the Trimble custom mill. Some of this ore is exceedingly rich in gold.

A discovery of interest has been made in the central part of the Manhattan district, 50 miles north of Tonopah, where a quartz vein has been opened by a crosscut at a depth of 165 ft. below loosely bedded schist. Matt Kane, who owns a custom mill near by, has been working the ground with two partners and reports that he is supplying ten stamps of his mill with ore of good grade from the newly found vein. High-grade ore from seams near intersecting fracture planes is sacked for shipment to a smelter.

Rich gold ore was found recently in the National mine in northern Humboldt county, reopened after thirteen years by Frank Stall, who has re-equipped the old mill. Three miles to the south, the newly completed 50-ton cyanide mill of Nevada Lucky Tiger, subsidiary of Lucky Tiger-Combination, is treating ore from the No. 1 vein of the Buckskin National mine, held under option.

A 40-ton calcining plant is to be constructed at once near Luning, Mineral County, a station on the Mina branch of the Southern Pacific Railroad, to treat brucite from a large deposit purchased from Harry Springer by United States Brucite, with offices at Oakland, Calif. The deposit is in northwestern Nye County, 34 miles by road from Luning, and the product will be trucked to the plant, situated at the nearest rail point.

Plans for construction of a large-capacity flotation mill, probably with secondary leaching, are expected to be announced soon by Como Mines, as development on the level of the transportation and drainage tunnel is said to have blocked a large tonnage of mill ore. Laterals from the main adit, both headings now nearly a mile from the portal, are being advanced in the Como and Rapidan veins and have opened ore from 10 to 40 ft. wide. A raise has been driven to the old Rapidan incline shaft and another will soon be driven to the Como shaft workings, affording good ventilation. Deep winzes are to be sunk in both orebodies to ascertain the character of ore below the water level, although in the Como vein the water table has been well above the adit, from which the flow is about 700 g.p.m.

West of Goodsprings, in the southern tip of Nevada, several projects are developing and employing numbers of workmen. A cyanide mill is to be constructed at the Chiquita mine, in which, reports indicate, large bodies of pay ore have been developed to a depth of over 800 ft. California men are developing the merged Keystone and Barefoot mines at the east. Las Vegas operators have provided equipment to work the property of Yellow Jacket Mining.

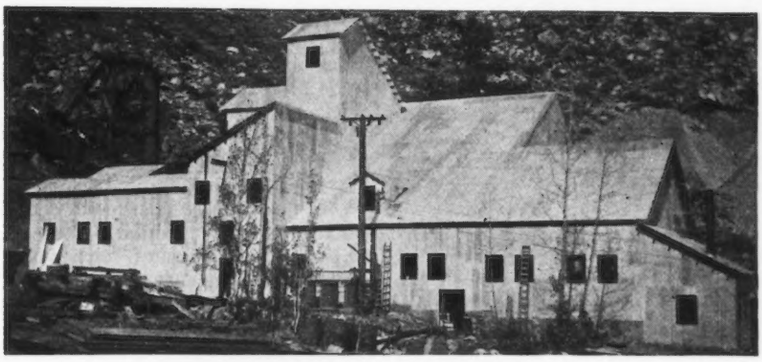
Following completion of a 40-ton amalgamating mill on its Dixie Comstock mine, in Dixie Valley, discovered last summer by Clyde Garrett, Comstock-Keystone, operating the Keystone and Justice mines, near Silver City, under the management of E. A. Montgomery, has given an option to purchase the Dixie Valley property and mill to Pardners Mines, of New York. The latter organization, with Charles Mayotte as engineer manager, has undertaken to sink the working shaft started by the Comstock-Keystone, which is now 60 ft. deep. The vein at its outcrop is over 40 ft. wide, with a width of 10 ft. or more of high-grade gold ore at the hanging wall. Test mill-runs were made at Silver City on 175 tons from this part of the vein.

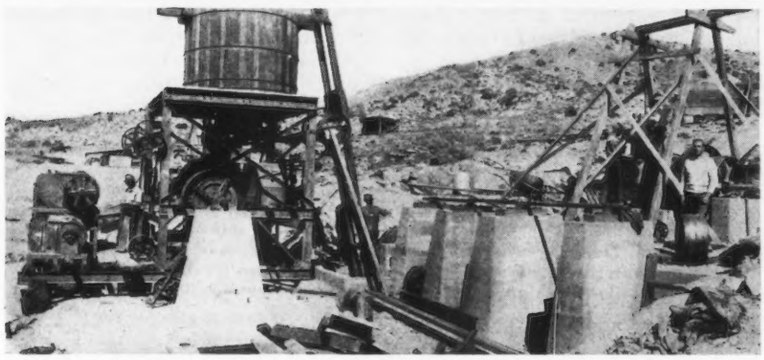
Applications may soon be made for RFC loans to mine and mill gold-silver orebodies of the Comstock lode in addition to the loan of $165,000 granted to Sutro Tunnel Coalition for the purpose of mining a blocked orebody in the Crown Point mine. Mines at the north end of the lode, including sections of the Ophir and Consolidated Virginia, have been subjected to thorough sampling and are declared to contain a large tonnage of good mill ore above a depth of 500 ft.

Construction of an initial 40-ton flotation unit is in progress at the Dixie Valley mine of Comstock Keystone, following delivery by truck of 170 tons of ore from the lately opened property to the Trimble custom mill, at Silver City, for test runs. Amalgamation may also be employed, as the ore is oxidized. The orebody is of substantial width, crosscut for over 60 ft. by a shallow tunnel, with a section 15 ft. wide that contained high-grade ore. Comstock Keystone lately purchased the old adjoining Justice mine, at Silver City, and has opened good milling ore on two levels in clearing the Woodville shaft, near the bed of Gold Canyon. E. A. Montgomery is president and manager.

Work has been started in the Old Lincoln lead mine, 4 miles northeast of Minersville.

Two New Flotation Plants





Above—Cardinal Gold Mining replaces plant recently destroyed by fire with a new flotation mill of 150 tons' daily capacity, at its property near Bishop, Calif. W. V. DeCamp, general manager of the company, is in charge of operations. Below—Gordon Gold Mines erects a compact milling plant at its property near Silver Peak, Nev. The flowsheet, based on extensive laboratory tests, includes flotation and amalgamation treatment. Rated capacity of the plant is 20 tons per 24 hours, grinding to 5 per cent plus 65 mesh

Mexico Approves Labor Agreements Affecting Large Mines

National Government Establishes Experimental Laboratory at Mexico City—Shipment of Mineral Products by Airplane Expands—Two Companies Transport 281,053 Kilos in 1,071 Flights During 1933

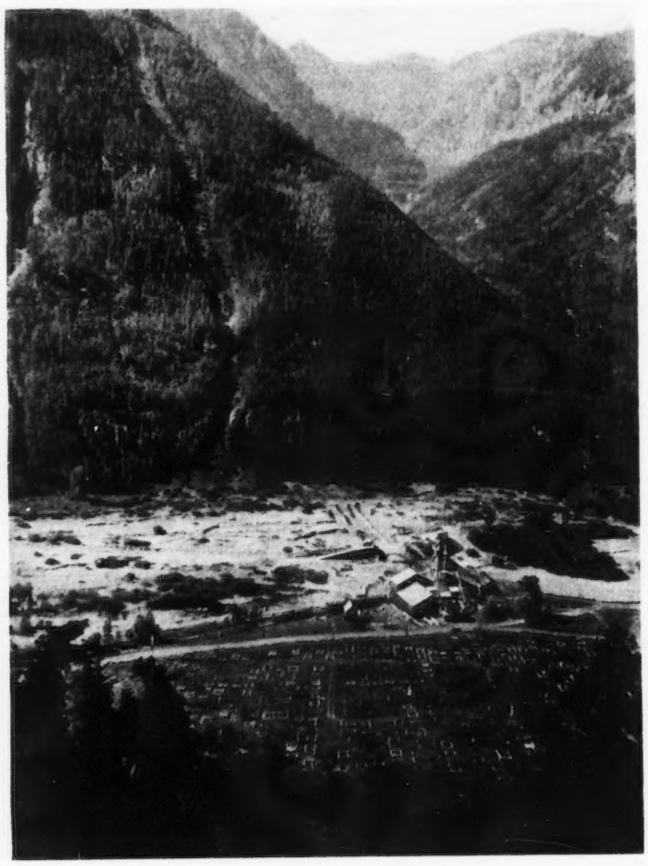
LABOR difficulties of American Smelting & Refining in its Angangueo, Michoacan, unit and San Pedro and El Barreno units, San Luis Potosi, and of San Luis Mining in its Taylorita unit, Durango, have been settled as the result of agreements made with workers and approved by the federal labor department. American Smelting granted its Angangueo workers a wage increase, four full days holiday a year with pay, and annual vacations of from eight to ten days with wages. . . . The Ministry of National Economy has established an experimental metallurgical laboratory in its mines department offices in Mexico City for the purpose of assisting the mining industry in general and small-scale miners in particular. The laboratory is completely equipped for microscopic examinations, assays, and metallurgical tests. . . . Mining companies in Mexico are speeding mineral deliveries by aviation, as shown by the report of the Ministry of Communications and Public Works covering air traffic in the republic last year. According to this report, planes carried minerals from the Taylorita, Durango, zone to Mazatlan, a West Coast port, in 35 min., as compared with eight days required by overland routes. In 1933, the Cia. Aeronautica de La Sierra, subsidiary of West Mexican Mines, carried 155,392 kg. of minerals in 455 flights, and planes of San Luis Mining, 125,661 kg. in 616 flights.

Mexico's first mining industry financing bank, the Credito Minero y Mercantil, has begun operations in the Bank of Mexico building, Mexico City. The institution has a capital of 1,250,000 pesos (about $350,000 U. S.). Its stockholders include all the leading Mexican banks and American Smelting & Refining, Real del Monte Mining, Peñoles Mining, Cia. Minera Las Dos Estrellas, and the Wells Fargo Express Company of Mexico. Raul Bailleres, prominent Mexican mining man and banker, is president, and James R. Woodul, general manager of American Smelting & Refining, and Michael H. Kuryla, managing director of Real del Monte Mining, are among its directors. The bank is buying gold, silver, mercury, tin, and precious metals and is managing and financing metal and mineral shipments from the mines to any part of the world. . . . Zacatecas Mineral Producers' Union, composed of cooperative societies of miners organized by the federal and state governments, is arranging to install a metal-treatment plant to cost 100,000 pesos (about $28,000 U. S.) at Zacatecas City, so as to handle ore that it extracts instead of depending upon the plants of Fresnillo Mining.

Cia. Minera El Lucero has resumed work in mines and plants that were owned by the Cia. Minera Angustias, Dolores y Anexas, in the Pezos zone, Durango, and has installed a cyanide plant there. . . . Cia. Explotadora de Minas de Oro is working the San Felix and San Juan de la Chica mines and is installing a metallurgical plant in Durango. . . . San Francisco Mines of Mexico is working all its mines in Chihuahua. . . . Cia. Minera El Progreso is operating a smelter at Baborigame, Chihuahua, and Cia. Minera Hermes has begun work in the Yoquivo zone, in that State. . . . Santa Maria del Oro Mining is installing a 740-hp. electric plant at its property in Durango, and Cia. Explotadora de Durango is working the El Porvenir mercury mine, at Santa Maria del Oro, in that State.

Work has been resumed in the famous old Plateros mine, Fresnillo municipality, Zacatecas. . . . The La Luz mine, Tejame region, Durango, has an average daily silver production of 20 kg., and other silver mines in the zone are being developed. . . . Additional explorations are being made in the old La Bonanza, Extension Norte de la Bonanza, Extension Sur de la Bonanza, and El Porvenir mines, Imuris district, Sonora. . . . Cia. Minera de Peñoles is arranging to intensify work in its El Jardin and Maravillas tracts, Nieves municipality, Zacatecas. . . . Work has been resumed with a force of about 400 men in mines in the Asientos region, Aguascalientes, owned by Geronimo Elizondo, as the result of the agriculture ministry settling disputes with agrarians over water rights. Work in these mines was suspended because of a lack of water. . . . Charges of clandestine mining to defraud the government of taxes and the theft of ore in the Taxco region are being probed by the Guerrero authorities.

In the Telluride district of Colorado. Structures shown comprise the milling plant of San Juan Metals Corporation, which has been in operation since June 1, treating tailing from the old Smuggler-Union, Liberty Bell, Tomboy, and Cimarron properties. The plant is equipped with modern regrinding and flotation units and has a capacity of 400 tons of tailing a day



NEWS FROM WASHINGTON

COOPERATION between business and the Administration has been much closer since the election. The overwhelming support given President Roosevelt by the electorate was proof to business that whether or not it likes the New Deal, it is certain to be in the saddle for some time to come. For that reason those elements that were holding back expecting the Administration to receive a rebuff now realize that they must work with it. At the same time, the Administration is in a position where it is in its interest to cooperate with business, as it must have the help of this element in curbing wild expenditures and other legislative excesses. Then, too, as the depression has continued, the Administration and the public have come to realize more keenly that, after all, what the Government can do can employ only a small proportion of those needing work. Chief reliance must be placed on private enterprise. Already efforts to encourage private business are being redoubled. Further steps in that direction may be expected. Conditions under which direct loans are being made to industry have been liberalized greatly. Every effort to remove monetary and other uncertainties is being made. Public-works projects that may be appropriated for at the next session will be of the type from which quick results can be obtained.

Unless business does take hold, there is no prospect that the Administration can convert relief into recovery. Significant is Secretary Roper's statement that no government can stand on the policy of increasing unemployment. That is what happens when the dole becomes preferable to wages. And that is the reason why Roosevelt is constantly building up the idea that local communities and charitable organizations must shoulder the responsibility for caring for the chronic unemployables, thus stemming the drain on the federal treasury, forestalling any heavy increases in taxes at this time, and permitting the Administration to throw its resources into a program of diversified public works, on a reimbursable but not a strictly self-liquidating basis, that will furnish orders for equipment and materials.

Next Congress

Although proposals for wild spending and drives for inflation will characterize the next session of Congress, the general feeling is that the President can dominate the situation and will keep it within reasonable bounds. Even though a considerable number of radically inclined persons have been added to the membership of the Senate and the House, they realize that they were carried into office on the popularity of Mr. Roosevelt. They are inexperienced as legislators, and the chances all are that they will continue to cling to the President's coat tails. Nevertheless, the influence of the President over Congress will move with the business index. If business improves, the President will be in a much stronger position than would be the case if a further decline occurs. Two big battles will be fought over the soldiers' bonus and the amendments to the National Industrial Recovery Act. A politically minded Administration is expected to work out a compromise with the veterans. Codes of fair competition are expected to receive the sanction of Congress, but this departure from the principle of the Sherman and Clayton acts will not be attained without long and acrimonious debate. Adoption of an unemployment insurance law is practically certain.

Silver Purchases

Hope of further large-scale purchases of silver has been abandoned. When China stopped silver exports it spelled the doom of the silver-buying program in so far as effect on prices is concerned. It already was known that no great amount of silver could be expected from India, the other great storehouse of the white metal. Even the high prices of world war days failed to draw any large amount of silver out of India. The purchasable supply is relatively small. The real stores are in the form of jewelry and ornaments, which are cherished to an even greater extent when the value goes up.

Affairs Russian

Indefiniteness and uncertainty shroud practically everything Russian. Soviet statistics are questioned. Little information of a precise character with regard to the possibilities of trade with the United States is available. It quite apparently is to Russia's advantage not to disclose its commercial policies at this time. In that way it is in a better position to trade. Most of the articles being published on the possibilities of Soviet trade are characterized as "guessing" by those who are most familiar with the situation. It is the prevailing opinion in Washington that ultimately some plan will be worked out, but no one in authority will venture an opinion as to how long it will take or what the final conditions are likely to be. Although few are willing to accept the estimate that Russia will produce $150,000,000 of gold this year, it is known that gold production there is increasing and under the stimulus of the present high price a steady expansion of that industry is certain. This probably means increased purchases of American mining machinery.

Two shipments of gold ore have been made recently from Leningrad to the Tacoma (Wash.) smelter of American Smelting & Refining, according to A. J. Rosenshein, head of the Amtorg Trading Corporation. These shipments, together with a small trial shipment made several months ago to the Carteret, N. J., plant of American Metal, amounted to 23,000 tons, valued at $1.7 millions.

Gold production in the U. S. S. R. increased 50.5 per cent in the first nine months of this year, compared with the corresponding period of last year, according to the *Bulletin* of the U. S. S. R. Chamber of Commerce. A total of 23 electrically operated gold dredges is said to be in use.

Mining Loans

Although only one loan had been made up to Dec. 3 by the Reconstruction Finance Corporation under the mining paragraph of its act, investigations of more than 100 applications have been going forward steadily. Much time is being lost through the necessity of having to return applications for additional data. Each applicant is required to show assay returns. Many fail to give the width of the vein and other conditions under which the sample was taken.

Delay also is hard to avoid in making arrangements for the examination of the mine after the application has been perfected. The RFC picks an engineer in the locality from which the application comes and asks him to send in an estimate of the cost of the examination. Sometimes the estimate is higher than the RFC engineers feel is justified under the existing conditions. This frequently requires time-consuming correspondence. Once the RFC is convinced that the fee is reasonable, the applicant is advised as to the amount. The applicant must pay all costs of the examination, but he is at liberty to make any terms for payment that he can arrange with the engineer the RFC has designated.

Inquiries concerning loans are reaching the RFC at the rate of ten a day. These indicate that the terms of the law are not well understood. Most of the inquiries deal with prospects. Unless a property has ore blocked out it may not be made the basis for a loan. Numerous correspondents do not realize that loans may not be made on properties in Mexico or Canada. Applicants are being cautioned to incur no expense until their property has been approved for examination.

Two applications before the RFC engineers cover large, well-developed properties, and involve relatively large sums. Practically all of the 125 formal applications now pending, however, are for small properties.

Bureau of Mines

After an extended trip through the West, John Wellington Finch, new director of the Bureau of Mines, is convinced that the promptness of recovery depends to a great extent upon the amount of initiative shown by enterprise. He points out that the Administration is doing many things which should stimulate business. In his Western contacts he urged cooperation in these activities, even if there is not complete accord with everything the Administration has done or is doing.

Dr. Finch has a strong conviction that a federal scientific and technologic agency such as is the Bureau of Mines should not undertake work that can be done by the several states, by the universities, or by individual mining companies. He realizes also that a research agency must orient its work to the needs of the industry that are not cared for by the other agencies.

British Machinery Manufacturers Benefit From Gold Boom

Correspondence from London

THE REVIVAL of gold mining, due to the higher price of the metal, has brought an immense volume of machinery orders to Great Britain. For instance, the Erith works of Fraser & Chalmers are operating night and day, on orders for mining and milling equipment coming chiefly from the Rand, East and West Africa, and Australia. As this activity is giving stimulus to coal mining and steel making, new orders are coming in for coal-washing and iron-mining equipment, and these in turn are creating a demand for still other characters of machinery.

This excess of demand for gold mining and milling equipment is apparently not confined to Great Britain. P. M. Anderson, chairman of Van Dyk Consolidated Mines, remarked at the recent meeting of that company: "Some delay is expected in obtaining delivery of winding engines, as overseas manufacturers appear to be fully occupied with orders."

A progressive decline in the grade of ore treated by the Rand mining companies (the average has fallen 1½ dwt. per ton since 1932 and was only 4.85 dwt. in August this year) has provoked a renewal of the controversy as to whether richer or poorer ores should be treated while the price of gold is high. To the argument that the high price of gold makes the working of lower-grade ores profitable, and so lengthens the life of the mines, the reply is that this will be for the benefit of future shareholders. Present shareholders should not make sacrifices to that end but should reap the benefit in dividends of the prevailing prosperity. Nothing has apparently been said regarding the ability of the mining companies to extract sufficient higher-grade tonnage to feed their mills to capacity.

G. H. Beatty, vice-president of the Transvaal Chamber of Mines, has pointed out that, on the standard price for gold, 17 mines representing 48 per cent of the ore being crushed would today be working at a loss. The average profit, he declares, is more than 8s. per ton at present. He maintains that it is to the country's interest to work the low-grade ores at present.

From another quarter comes the opinion that if the government would provide for a fixed basis of taxation over a long period of years the companies would be encouraged to erect plants and otherwise arrange for a largely increased tonnage output. The declaration is made that though this might not result in larger dividends, it would assure good dividends as long as gold continues at anything like its present price, and that the government itself would profit greatly by helping the mining industry in this way. The latest advices from Johannesburg state that the mining companies, yielding to the insistent demand, have decided to raise immediately the average grade of ore treated.

October output of the Witwatersrand gold mining district was 829,027 oz., and of neighboring districts 56,600 oz. This total of 885,627 oz. compares with 837,442 oz. in September and with 908,888 oz. in October, 1933. Value of this year's October output, about £6,200,000, is greater than in any previous month of the district's history.

The claim is made that the South Deep shaft, in the Simmer & Jack property, on the Rand, will be the deepest vertical shaft in the world. Sinking began July 1, and a depth of about 1,000 ft. has been reached. Expectations are that it will be completed to a depth of 6,500 ft. by the end of 1936. The reef should be cut at a depth of 6,100 ft.

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Lena Goldfields and Soviet Reach Agreement

After four and a half years of litigation and negotiations, an agreement has been reached between Lena Goldfields and the Soviet Government of Russia. It provides that the latter pay the former £3,000,000—£50,000 in cash and the remainder in varying installments spread over twenty years—and also that it assume the company's indebtedness in Russia, which is said to be about £737,000.

History of the controversy is, briefly, that in December, 1929, the Soviet arbitrarily canceled the leases under which Lena Goldfields worked several properties, chiefly in Siberia. In the following February the company brought suit in England. The case was heard by the Arbitral Tribunal, the Soviet declining to be represented, and Lena Goldfields was awarded £12,965,000 damages with interest at 12 per cent from the date of the award.

As the Soviet refused to be bound by this decision, negotiations were opened. At first the Soviet is reported to have offered £1,000,000, but continued negotiations resulted in the agreement already stated. This agreement will have to be ratified by Lena Goldfields shareholders before it becomes operative. If ratified, Soviet notes will be issued for each of the future payments. The Soviet claim has been that the company was failing to pay over the stipulated portion of the gold recovered.

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Billiton and Singkep Mines May Be Closed

A plan is being worked out for the fusion of the Dutch East Indies Government tin mines at Banka with the Billiton Maatschappij (Billiton Tin Company), and is expected to be laid before the People's Council at Batavia in January. If the fusion is effected, the belief prevails that the Billiton and Singkep mines will be closed and productive operations concentrated on the Banka mines.

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Selection Trust Secures Option

An announcement has been made that Selection Trust has secured a four months' option to acquire a substantial interest in Rooderand Mines. This company holds what is described as an island of the Witwatersrand Series, which exists near the border of the Orange Free State, between Parys and Potchefstroom, ground which has not so far been tested.

The Francoeur property, in Beauchastel Township, Rouyn district, Quebec, one of the more important mines in this active area. A shaft, inclined at 50 deg., has been sunk 300 ft. to develop the Francoeur deposit, part of an extensive gold-bearing zone which is also being developed in the adjoining Arntfield mine

Most Canadian Base-Metal Mines In Fortunate Position

Low Prices Emphasize the Resultant Effect of High-Grade Ore and Byproduct Output—Splendid Technical Management Responsible for Continued Exploitation of Medium-Grade Ore in Difficult Period

THE fortunate position of the principal Canadian base-metal mines is emphasized in the present period of low prices. With the exception of Flin Flon, Anyox, and Britannia, all have ore has been encountered on the lateral low-cost metal, the copper of the Sudbury mines and Noranda being under present conditions a byproduct. The present slump in copper prices has reduced the earnings of the copper companies during the third quarter of the year, but International Nickel, Falconbridge Nickel, and Noranda have maintained their dividend rates in spite of this. The splendid technical management at Britannia, Anyox, and Flin Flon has been mainly responsible for the continued exploitation of their medium-grade ores during this difficult period. A new prospective producer in Quebec is Normetal (formerly Abana), 50 miles north of Noranda, where Mining Corporation has developed substantial bodies of copper-zinc ore down to the 800-ft. level.

Ontario

Pickle-Crow, in the District of Patricia, is rapidly developing a substantial tonnage of ore, the length of the ore averaging 800 ft. on the three levels under way. The 125-ton mill is expected to be in operation next month.

The 100-ton mill of Canadian Matachewan (sponsored by Ventures, Ltd.) is in operation. Unlike its neighbor Young - Davidson (Hollinger subsidiary) whose low-grade ore is being mined in bulk, it will mine selectively from zones in which the grade of the ore is fairly well defined. Ernest Craig, manager of Falconbridge Nickel, has directed the development of this mine.

Northern Empire, subsidiary of Newmont, has increased the capacity of its mill at Beardmore from 90 tons to 150 tons.

Manitoba

Establishment of the San Antonio property as a high-grade mine of medium size, with the possibility of growing into a major producer of gold, has led to the exploitation of its neighbor on the east, Forty-Four, whose ground is almost entirely under water. A drift eastward from the 600-ft. level of the mine is 500 ft. into Forty-Four ground, and diamond-drilling from it has given some intersections of medium grade and size which are being followed. The objective of this exploratory drift is to reach veins shown in drill intersections 1,700 ft. east of the boundary with San Antonio made from the ice last winter. Results have shown, therefore, that Forty-Four has at least 1,300 ft. of the gold-bearing zone. San Antonio's new central shaft is completed to a depth of 1,000 ft., and three new levels have been established. This will permit raising the daily tonnage beyond the present 300 tons to a figure more in keeping with the mine's potential output.

Central Manitoba, whose gold veins have become unpayable at comparatively shallow depths, has decided to diamond-drill at depths from 1,000 to 2,000 ft.

Quebec

The McWatters mill, in Rouyn, is treating 50 tons a day of gold ore of good grade. Although ore has been found only in the upper levels so far, hopes are that information gained in taking out this ore will provide a clue to ore at greater depths.

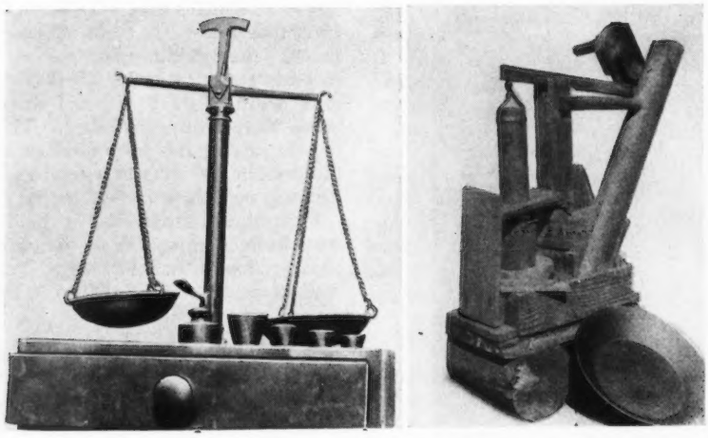
British Columbia

Stations have been cut down to the 19 level, at a depth of 2,200 ft., at the Pioneer mine, and the No. 2 shaft is being carried down rapidly toward its immediate objective of 3,100 ft. Meanwhile, some exceptionally high-grade ore has been encountered on the lateral developments on the lower levels.

Interesting accounts of progress at the Morning Star mine, in the Fairview camp, were presented at the recent annual meeting of the company. Following an exhaustive examination of the old workings of the Stemwinder property, the company has decided to drop the options held upon this ground, covering the northwesterly extension, as formerly supposed, on the Morning Star vein system. The Stemwinder vein is now held to belong to a different system, and a co-ordinated system of development would entail unprofitable expense.

At the annual meeting of Congress Gold Mines, held recently, the consulting engineer reported that the ore zone, as exposed to date, is variable in width, with no geologic walls bounding it. The zone follows a fracture which has been followed in No. 3 tunnel, for over 400 ft., and exposures of a similar character are found at surface some 3,500 ft. ahead of the workings. The gold is closely associated with fine grade arsenopyrite, and the engineer states that an economic tonnage of a value between $5 and $8 per ton, according to the width mined, may reasonably be expected. Further development work is recommended before entertaining plans for milling equipment.

The 50-ton mill on the Wayside property has been put into operation, treating fairly high-grade ore which is found in streaks in the wide shear zone which constituted the objective of previous extended development. Developments on lower levels are reported to have



Old Balance and Stamp Mill

Left—Balance, dated 1856, used by gold buyers at Mokelumne Hill, Calaveras County, Calif., during the early 'sixties.

Right—Stamp mill made by early miners in the Mountain Ranch mining district; a crude but also a rather ingenious device.

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The cam and beam of the stamp mill are made of 1-in. white pine. Metal strips on the under side of the cam and the top of the beam reduce the wear on the cam to a minimum. The pestal is raised on the downward swing of the crank. Both the balance and stamp mill are owned by the Mokelumne Hill Laboratories, Mokelumne Hill, Calif., which firm made available the photographs of the above reproductions

improved the prospects for profitable operation on a moderate scale. This property has become the third producer in the Bridge River area. Rapid construction work has been carried out on the mill for the Minto property.

Sally Mines, Ltd., has entered a new stage of profitable operation after encountering the Wellington vein in workings that were driven from a shaft which was recently sunk on the Sally property, in the Beaverdell camp. Two parallel shoots of ore have been encountered. These veins have been opened up to date by drifting over a distance of about 43 ft. Development of this mine has been under the direction of R. H. Stewart, consulting engineer, of Vancouver. Steady production will probably be maintained henceforth.

B.R.X. Gold Mines has decided to follow the recommendations of Col. H. H. Yuill, and to concentrate efforts upon the exploration of the northwestern section of its holdings, where geological conditions are reported to be much more favorable to the occurrence of the typical veins of economic importance in this area than the California section toward the southeast, where all recent work has been concentrated.

At Britannia, little change has occurred in the type of operation during the past month. The distress market price of foreign copper at a fraction over 6c. does not provide a promising outlook for low-grade operations. The company's exploration work has been practically suspended for the season.

The 50-ton mill of Island Mountain, in the Cariboo, has been put into operation, and developments at the mine are believed to be particularly encouraging in view of the possibilities indicated by the new type of orebody which has been opened up in the tunnel workings. This deposit is a replacement in a limy bed. Similar occurrences on a minor scale have been encountered in the Cariboo Gold Quartz workings, and more particular attention will be paid to them in future development. At the latter property production is being stepped up, and, owing to the lesser proportion of ore from development headings going to the mill, a higher average grade is being maintained. Placer mining prospects in the Cariboo have improved lately, and several operations on a major scale are in progress.

Successful results are reported from developments that have been in progress at the Two Star mine, in the Ymir camp. This property is controlled by A. D. Trites, of Vancouver, who decided last year to drive a long crosscut tunnel with a view to exploring for the continuation of the Yankee Girl vein at depth. An orebody is reported to have been encountered in this tunnel at a distance of about 2,960 ft. from the portal, which is believed to represent the objective of this work. Two other veins have been cut, and drifting work is in progress.

Reconstruction of the power plant of Premier Gold Mining is in progress. The destruction of this plant by fire was at one time thought to threaten the continuance of operations at the mine, but the damage was covered by insurance. No time is being lost in putting the property back again on a normal footing. In the meantime, work at the mine is being carried on under diesel-engine power, and transport of the ore from mine to mill is being handled by road.

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Trepca Mines Raises Rate Of Ore Treatment

Trepca Mines, operating in Yugoslavia, treated 50,704 metric tons of ore in September, which yielded 5,387 metric tons of 79.49 per cent lead concentrate carrying 23.7 oz. of silver per ton and 8,266 metric tons of 50.65 per cent zinc concentrate.

Trepca has raised its ore treatment above 50,000 tons a month, it having been 50,706 in June and 50,729 tons in July. This is being done in a mill designed for a capacity of 750 tons daily, or 22,500 tons monthly. In August a high record was attained by the treatment of 51,420 tons of ore.

Mine developments have continued favorable. A recently completed borehole has proved that the Stantrg orebody persists in width and grade at a depth of 1,000 ft. below the deepest adit level. It has previously been proved only 600 ft. below that point. In Trepca's Mazic prospect, now being explored, the discovery has been made that the ore was mined down to the water level in the Middle Ages. The great horizontal area of the old workings indicate that a large orebody, probably even larger than that in the Stantrg mine, will be found below. This ground is being explored by means of an adit, from which a winze has been sunk, and from the latter drifts and crosscuts are being extended.

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Further Discoveries Reported In Kakamega District

Continuing favorable discoveries are reported being made in the Kakamega district of Kenya Colony, in East Africa. Kimingini Gold Mining, controlled by the Sir Robert Williams & Company group of companies, is reported to have proved by diamond drilling that its Musgrave Reef persists in width and values to considerable depth. Two boreholes 250 ft. apart show widths of 29 in. and 40 in.

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Kentan Gold Areas Options More Claims

Encouraged by its developments in the Kakamega and Tanganyika Territory fields, Kentan Gold Areas has secured options over some 60 additional claims in the former district, which are said to carry the veins being developed by Kimingini for a further distance of 1,800 ft. About 30 miles of the Songwe River in Lupa Goldfield has also been optioned. This stretch of the river drains an area from which over 100,000 oz. of alluvial gold has been recovered, and its sediments are being tested by Banca drilling.

Revival of Gold Mining Continues Unabated in Australia

Western Australia Center of Operations, With the State Providing Milling Facilities and Other Aid for Prospectors and Small Companies —Tasmania Tin Production Will Probably Increase

WESTERN AUSTRALIA continues to be the center of gold-mining interest in Australia. Many of the mines, after months of diamond drilling and underground exploratory work, are reaching the stage where productive operations are justified. Work on some of the neglected fields, such as Meekatharra, Norseman, and Ora Banda, is yielding excellent results. The Meekatharra dike formation will be worked by at least four companies, and an important increase in the gold yield of the State should result. Norseman and Ora Banda have been hampered in the past by inadequate development. Much activity prevails at Wiluna, where leases for many miles north of the main Wiluna lodes have been pegged. The scheme of providing State batteries for treatment of gold ore won by a prospectors' syndicate and small companies is functioning excellently, and assisting greatly the revival of mining in the State. The State battery system is also in operation in South Australia, New South Wales, and Queensland. In the last-mentioned State portable batteries are available.

A large increase in the output of tin in Tasmania during the next few years is probable. Burma Malay, Ltd., is believed to have exercised its option over the Briseis alluvial tin mine, at Derby. This property was a steady producer up to 1929, when the bursting of a large storage dam flooded the mine and destroyed the plant. At least 5,000,000 cu.yd. containing 3,700 tons of tin oxide is available. . . . Endurance Tin Mining, at South Mount Cameron, is installing two hydraulic units to treat 1,500,000 cu.yd. of wash, from 2 to 16 ft. thick, containing 500 tons of tin oxide. A large area of deeper ground is also available. . . . Capital is being obtained in London to develop the Brookstead leases in the same district, on which extensive test boring has given favorable results. . . . Siamese Tin Syndicate is in regular operation at St. Helens and has a large area containing 1 lb. of tin oxide per cubic yard for shallow sluicing. . . . A report prevails that the Mount Bischoff company is to resume operations on its own account after being in the hands of tributers for years.

A summary of the principal mining developments in the several states during recent weeks follows.

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Western Australia

Beryl Gold Corporation has been formed in London by Anglo-Australian Gold Development to carry out exploration on the beryl mines at Kundip. Diamond drilling and underground development are in progress.

Australian Mining Trust has floated its third subsidiary, Ingliston South Gold Development, to develop a property at Meekatharra.

Wiluna Gold Mines continues to treat 40,000 tons or more monthly at a cost of 19s. per ton and a profit of 26s. per ton. On the Squib lease, 6,700 ft. north of the main shaft, a surface diamond drill hole has proved low-grade sulphide ore 13 ft. wide at a depth of 330 ft. This lease immediately adjoins the western boundary of the Bulletin lease, on which a new shaft is being sunk. The company has spent more than £60,000 in the provision of workmen's houses, club-rooms, and swimming pool, and gives employment to 800 men.

The new treatment plant of the Great Boulder Proprietary, which embodies flotation, roasting, and cyanidation, is now in full commission and is treating 12,000 tons monthly. Research work on the treatment of the company's two dumps—one containing 1,900,000 tons assaying 1.65 dwt. and the other 1,000,000 tons assaying 1.035 dwt.—is in progress.

The new mill on the Lancefield mine, at Laverton, which will have a capacity of 12,000 tons monthly, will be in operation before the end of the year. The mine, which closed down in 1921, has been unwatered.

Norseman Gold Mines is installing fine grinding, classifying, and cyanide equipment to provide a capacity of 5,000 tons monthly, or double that available at present.

Ora Banda Amalgamated Mines, formed to test three contiguous leases at Grants Patch, will probably develop into an important producer. A treatment plant, with a capacity of 1,500 tons monthly, is being erected. This plant will be extended when present exploratory work to the 260 ft. level has been completed. The ore will be crushed in a 10-head, 1,250-lb. stamp battery, and the pulp, after passing over corduroy strakes, will be ground in a tube mill operating in closed circuit with a classifier. The product will be agitated, cyanided, and filtered on an Oliver filter; and the gold will be recovered on zinc shavings.

Triton Gold Mines, formed to develop and equip the Reedy's mine, at Cue, is proceeding with the design of a mill and has placed orders for a power plant.

Following its aërial survey, Western Mining Corporation has secured leases in the vinicity of the Lancefield mine, at Laverton. This mine is being unwatered, and a mill to treat 12,000 tons monthly is being erected. The aërial photographs showed two distinct lines of lode extending for more than 20 miles.

Lake View & Star, at Kalgoorlie, which has been milling about 45,000 tons monthly, has augmented its power and compressor plants by installing a new diesel engine and a 2,250 cu.ft. compressor unit. The completed plant will consist of five diesel engines, each of 1,100-hp., five diesel-driven compressors, and one electrically driven compressor. On the surface, the railway from the Associated mine to the Lake View mill has been completed, and all ore from the Associated is being treated at the latter mill. The Chaffers shaft has now reached the 3,500-ft. level. The company is preparing plans for a plant to treat the Associated dump.

Lady Central mine, at Meekatharra, is to be developed and equipped by a new company, Meekatharra Central Gold. The lode consists of a number of rich sections, and mining operations on a large scale may be possible.

Queensland

Mount Morgan, Ltd., has taken an option over an area of 160 acres, 78 miles south of Wiluna, W. A.

Gold Mines of Australia has been granted large concessions embracing the principal part of the Charters Towers gold field. Geologists are engaged in an examination of old plans preparatory to unwatering. The company is also reopening the gold-antimony mine at Costerfield, Victoria.

Georgetown Gold Mines has been formed to develop a mine at Durham. Development has proved 22,000 tons of high-grade ore and prospects for finding additional ore are said to be excellent.

Victoria

A1 Consolidated, the most important company at work in the Woods Point district, is to install an additional eight stamps, bringing the total of the battery to 28. The mill is expected to handle 1,200 tons monthly.

Carshalton (B.M.L.) Mines has been formed by Bendigo Mines to test the Carshalton and Lancashire anticlinal lines at Bendigo. Other operating companies previously formed by Bendigo Mines are Napoleon (B.M.L.) Mines and Nell Gwynne (B.M.L.) Mines. These two companies have begun shaft sinking.

PERSONAL ITEMS

F. R. Koeberlin arrived in New York recently from Chile.

J. Whitehouse is back in London after a brief visit to Yugoslavia.

Paul D. Merica has been made a member of the board of International Nickel.

W. M. Reynolds has joined the staff of God's Lake Gold Mines, in northern Manitoba, as engineer.

G. McPherson, Jr., has completed a professional visit to New Zealand, and is returning to London.

H. J. C. MacDonald, consulting mining engineer, has opened an office at 30 Broad St., New York City.

E. C. Bloomfield has been appointed manager of the Tanganyika Diamond & Gold Development Company.

K. A. Creery has been appointed president of British Metals Corporation, with headquarters in Montreal.

Dr. Anton Gray returned to London from Canada in mid-November, and soon after sailed for South Africa.

Henry Bollweg, of Cananea, has been employed as engineer for Arizona Molybdenum Corporation at Copper Creek.

J. J. Byrne, formerly of Haileybury, Ontario, has moved to Toronto and opened an office in the Usher Building.

C. W. Dowsett, metallurgist of Dome Mines, has been retained by Kirkland Lake Gold Mines to rehabilitate its mill.

Norman L. Wimmler, mining engineer, has returned to San Francisco, Calif., where his address is 3427 Broderick St.

Jules Labarthe is developing the Tiblemont Island property, in the eastern end of the Quebec gold belt, for a New York group.

Richard Sawyer, of Butte, has been appointed general manager of the Virginia City Gold Mining Company, Madison County, Mont.

L. R. Moretti, mining engineer and geologist, has opened offices as a consultant in Suite 1091-1093 Mills Building, San Francisco.

Dean Wachtel, mining engineer, has left Duluth, Minn., for Ecuador, where he is employed by the South America Development Company.

W. Curphey, assistant general manager of Malayan Tin Dredging, Ltd., is manager of Clutha River Gold Dredging, Ltd., New Zealand.

A. H. Wahlrab, formerly of the Isle Royale Copper Company, has been appointed assistant to the manager of Hollinger Consolidated.

W. R. Lindsay, formerly mine superintendent for Granby Consolidated, is now general manager of Reno Gold Mines, Ltd., Salmo, B. C.

T. J. Welcker has been made chief geologist for W. F. Snyder & Sons, Salt Lake operators. Mr. Welcker succeeds the late **J. C. Ingersoll.**

J. E. Hilder has assumed the position of engineer and assayer with Hudson Patricia Gold Mines, Ltd., Narrow Lake, via Sioux Lookout, Ontario.

B. M. O'Harra, until recently with the American Smelting & Refining Company, is now with Eagle-Picher Mining & Smelting, at Joplin, Mo.

Andrew Arland, a graduate of the University of British Columbia, has been appointed superintendent at the Pilot mine, in the Bridge River area.

A. F. S. Anderson has resigned his position as manager of Bendigo Gold Sands, Ltd., to join the staff of New Guinea Goldfields, Ltd., in New Guinea.

Marshall D. Draper has concluded exploration and examination work near Dawson and at Mayo, Yukon Territory, and has returned to Los Angeles.

G. G. Dobbs and **W. S. McCann** are developing gold properties in Nova Scotia for Minerals Limited, subsidiary of Consolidated Goldfields of South Africa.

P. R. Bradley, president, Alaska Juneau Gold Mining Company, was a visitor recently at Juneau, Alaska, on a tour of inspection of the company's properties.

Dr. H. Foster Bain retired from the directorship of the Copper and Brass Research Association at the end of November. He has gone abroad on a holiday trip.

F. C. Tomlinson, mining engineer, has been appointed superintendent of the Henning-Maloney Gold Mines, Ltd., in the Flin Flon area of northern Saskatchewan.

Samuel B. Goldberg, who had formerly operated properties in the Orient, Mexico, and South America, has become assistant manager of Siscoe Gold Mines, Inc., in Quebec.

U. A. Jurva has left Alaska, where he was associated with Hammon Consolidated Gold Fields, and returned to Duluth, Minn., ill-health compelling his return to the United States.

Hubert O. Woods, assistant smelter superintendent at the Hayden smelter, A.S.&R., has been transferred to the smelter at El Paso, where he is in charge of sampling and ore handling.

E. P. Polushkin, formerly instructor in metallurgy at the School of Mines, Columbia University, has joined the staff of Lucius Pitkin, Inc., of New York City, as associate metallurgist.

W. B. Maxwell is now general superintendent and **R. L. Healy** assistant general superintendent of the Granby Consolidated Mining, Smelting & Power Company, Ltd., at Anyox, B. C.

E. L. Bruce and **H. C. Rickaby** have made a preliminary geological survey of the new Sturgeon River gold area east of Lake Nipigon, Ontario, for the Provincial Department of Mines.

Ivan E. Goodner, general manager for Consolidated Gold Fields of New Mexico and La Plata Mountains Gold Mines, Inc., of Colorado, has returned from an extended trip in the East.

R. E. Stavert, who has been president of British Metal Corporation (Canada) Ltd., since 1931, has been appointed assistant to the president of Consolidated Mining & Smelting Company of Canada.

H. F. McFarland has removed from Breckenridge, Colo., where he was foreman at the Arctic mine, to Morococha, Peru, where he is an engineer for the Cerro de Pasco Copper Corporation.

J. G. MacGregor, who has been associated with the late **Dr. J. H. Banks** in the development of the McMillan gold mine, in Ontario, has been appointed consulting geologist and is at present resident at the mine.

James MacNaughton, president and general manager of Calumet & Hecla Consolidated Mining Company, was recently awarded the Saunders Medal, for outstanding achievements in mining, by the A.I.M.E.

N. P. Norkin, director of Scientific Research Institute of Ore Dressing, Mechanobr, Leningrad, U.S.S.R., and the senior engineer of the same institute, **J. I. Ketko,** visited the Mesabi range recently.

T. Torell, superintendent of the copper refinery of the Boliden smelter at Rönnskär, returned to Sweden on Oct. 25, after a visit of several weeks at metallurgical plants in the United States and Canada.

Wallace Barlow has severed his connection with the American Potash & Chemical Corporation and is now an assistant in the geology department of the Virginia Polytechnic Institute, at Blacksburg, Va.

William F. Boericke has been appointed senior security analyst in mining on the Securities and Exchange Commission at Washington. He is the first mining engineer to receive an appointment on the Commission.

Royal S. Handy, superintendent of mills at Bunker Hill & Sullivan, at Kellogg, Idaho, will soon leave for Europe, where he will spend three months in an investigation of mining conditions on the Continent.

Herbert A. Megraw returned to New York on Nov. 1 after spending over eight years in Spain as vice-president and director general of Corchera Internacional S. A. He expects to resume practice as a metallurgical engineer.

Will H. Coghill, supervising engineer of the United States Bureau of Mines Mississippi Valley Experiment Station, Rolla, Mo., recently made a trip through Colorado, New Mexico, and Arizona, in connection with the ore-dressing studies of the Bureau of Mines.

John M. Bridge, general superintendent and engineer in charge of coal supply for the State Electricity Commission, Victoria, has accepted a position with Gold Mines of Australia, Ltd., Melbourne. Mr. Bridge was formerly underground manager of Zinc Corporation,

Ltd., and joined the state electricity commission in 1920.

Maurice G. McGrath received his master degree in metallurgy from the University of Utah last June and recently sailed for South America, where he is now acting as junior metallurgist in the research department of Cerro de Pasco Copper in Peru.

Lincoln Ehnbom has assumed the position of general manager at the Piermont mine, Aurum, Nev., which has resumed operations after a three-year shutdown. **F. M. Stephens** is superintendent and **M. F. Fairbairn** mill superintendent and metallurgist.

Henry C. Blee, son of J. W. H. Blee, manager of the Benzon Fluorspar Company, Cave-in-Rock, Ill., recently sailed for Freetown, Sierra Leone, West Africa, to become associated with the staff of the Sierra Leone Goldfields, Ltd., which is working an alluvial deposit 150 miles in the interior.

Charles C. Coulter, mining engineer, has returned to Denver, Colo., after an investigation, covering six weeks, of the placer deposits of the Cariboo district of northern British Columbia, for the Consolidated Cariboo Syndicate, consisting of a group of New York brokers. Dr. Coulter will open an office in Denver.

Colonel Percy E. Barbour has returned to New York City after a seven weeks' trip to Santo Domingo studying mineral possibilities there. Colonel Barbour recently received his promotion to a full colonelcy of the 363d Engineers, of which he has been in command for more than a year.

Dr. Otto Sussman was on Nov. 27 elected chairman of the board of the American Metal Company to succeed the late Ludwig Vogelstein. **Harold K. Hochschild,** vice-president, was elected president, and **Walter Hochschild,** secretary. **Arthur D. Storke,** of London, England, was elected a director of the company.

Walter Phelps Jacob has assumed the position of vice-president and managing director of Basin Montana Tunnel Company. He recently returned to his New York Office, at 341 Madison Ave., after a four months' visit at Butte, Mont., where he supervised the development of the mine and the erection of a new mill. Mr. Jacob is also a director and consulting engineer of the Beryllium Corporation and president of the Leonard Jacob Corporation.

Alfred B. Sabin is in active charge of operations at the cyaniding plant on the two and a half million ton tailing dump formerly operated by the Randsburg Aster Gold Mining Company at Randsburg, Kern County, Calif., and later taken over by the Anglo American Mining Corporation, Ltd. Hamilton, Beauchamp & Wordsworth have been retained as consultants to assist in the designing of a new plant.

Carl J. Trauerman, Butte mining engineer, president of the Montana Stock & Bond Co. and the Mining Association of Montana, has returned to Butte after making two trips east during the summer. He has been appointed Administration Member to serve on the Code (NRA) Authority for Division No. 45 (Montana and northern Idaho) of the Retail Solid Fuel Industry, with headquarters in Butte.

J. Raymond Coulter, formerly of Helena, a graduate of the Montana College, has been on a furlough to this country from Katowice, Poland, where for the last seven years he has been general metallurgical superintendent of the Giesche Spolka Akcyjna (Anaconda subsidiary). He has been visiting mining and industrial plants in this country, especially those controlled by the Anaconda Copper Mining Company.

T. W. Bingay retired on Oct. 1 as vice-president in charge of finance of the Consolidated Mining & Smelting Company, Trail, B. C. His service with the company covered a period of 38 years, during which he progressed from stenographer to executive. He was particularly active in promoting good industrial relations through housing plans, medical care, pensions, and group insurance. On his retirement he was guest of honor at a dinner given by the staff of Consolidated, and Kootenay friends and citizens.

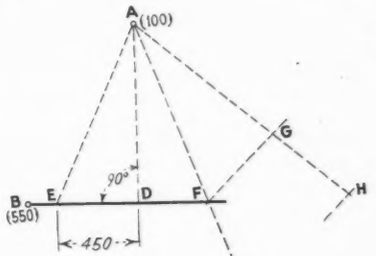
LETTERS

Finding the Strike and Dip Of a Bedding Plane

The Editor:

Geologists may find the following procedure for determining the strike and dip of a bedding plane, given three points in that plane, to be easier than some of the solutions of the problem given in textbooks:

Let the diagram represent the geologist's map, the elevations of the given



points *A, B* and *C* being noted in parenthesis.

Draw *AC* (that is, connect the upper and lower points).

Interpolate elevation 550 of intermediate point *B* in line *AC* at *F*.

Draw *BF*. Then the direction of *BF* is the strike.

The interpolation is a procedure familiar to topographers. Of several methods two are suggested:

(1) $AF = 450/700$ of the distance AC, where 450 equals the difference in elevation between *A* and *B* and 700 equals the difference in elevation between *A* and *C*.

(2) Draw any line *AH* and mark point *G* at 450 units from *A* and point *H* at 700, using some convenient scale. Draw *GF* parallel to *HC* intersecting *AC* at *F*. From Euclid $AG/AF = AH/AC$.

To obtain the dip take the section *AD* in the dip-plane which contains point *A*. Lay off $ED = 450$ on the scale of the map, and draw *AE*. This is equivalent to rotating the section plane about *AD* into the horizontal. Then angle *EAD* is the dip.

ROBERT G. DAVIES.

Santa Monica, Calif.

Mr. Davies' solution is correct and interesting. It represents the same analysis or method of attack that I have used for thirty years in trigonometric solution of the same problem.

His instructions or description of the solution are not quite as clear as they might be, particularly where he says: "Interpolate elevation 550 of intermediate point *B* in line *AC* at *F*." This could be elaborated to read: "Construct a right triangle with the hypotenuse *AC* and one leg *CH* equal 700, the difference in elevation between the vein at point *A* and point *C*. Determine by similar triangles a leg *FG* of length 450, the difference in elevation between points *A* and *B*. *F* then is a point of the vein having an elevation of 550, so that a line drawn from *B* to *F* will be a horizontal line in the vein or bed and hence a strike line."

One may also connect, sometimes more conveniently, the point of middle depth with either the deeper or the shallower point and determine on the vein a point either shallower or deeper to correspond, by extrapolation. This could be done either graphically, as Mr. Davies has done, or trigonometrically.

The analysis used by Mr. Davies, whether for graphical solution or for trigonometric solution, is much simpler than the usual trigonometric solution attempting to put into one very involved formula all the quantities. Occasionally, such complete formula will show a reversed image of the true conditions and it is not detectable from a formula alone. By attacking the problem in the general plan followed by Mr. Davies the problem is split up into several parts following each other in sequence and with no chance of getting a reversed solution.

WM. R. CHEDSEY.

Department of Mining,
Pennsylvania State College.

Is This An Altitude Record?

The Editor:

The Sangre de Cristo range in southern Colorado is the highest and most rugged in the United States. A portion of it bounding San Luis Valley on the east is known as Music Mountain, due to the melody heard when the wind blows through the sharp, rocky peaks. At the southern end of the range Mount Blanca rises majestically 14,464 ft.

The range is mineralized throughout, and many pieces of free gold float have been found assaying up to $12,000 per ton. The small streams flowing into the valley have proved attractive to placer miners. On a sloping plateau near the base of Mount Blanca, at an altitude of 14,000 ft., I sur-

veyed a mining claim 300x1,200 ft. I would like to hear from an engineer who has staked a claim in the United States at a higher altitude. EDWARD L. JONES.
Sale Lake City, Utah.

OBITUARY

George L. Kaeding, Nevada mining engineer, died recently at Los Angeles.

Thomas Henry Rosenberger, mining engineer, at Auburn, Calif., on Nov. 25; aged 52.

Charles B. Jacobs, metallurgist, died in Waterbury, Conn., on Oct. 18, aged 64.

Philip M. Kelly, chief mining recorder for the Yukon, at Dawson, Y. T., on Nov. 28; aged 61.

George E. Jenkins, retired consulting mining engineer, died on Nov. 19 at Dover, N. J.; aged 73.

Adelbert Fletcher Judd, mining man and industrialist, at Salt Lake City, Utah, on Nov. 19; aged 77.

Nels P. Flodin, well known in the Lake Superior Mining region, died at Marquette, Mich., on Oct. 15.

Gus Peterson, pioneer mining man of Baguio, Philippine Islands, died recently at Manila; aged 66.

H. P. Bellinger, retired mining engineer, was found dead near his home at Washington, Conn., on Nov. 25.

Dr. Collier Cobb, professor of geology at the University of North Carolina, at Chapel Hill, N. D., on Nov. 28; aged 72.

Russell M. Bennett, long a prominent figure in Minnesota, as well as Alaska, Mexico, and Brazil, died in Minneapolis on Oct 31st, aged 69.

Juan Guzman, prominent mining man of Talpa de Allende, Jalisco, Mexico, was killed recently when an earthquake demolished his residence.

Frank Klepetko, mining engineer, long associated with Boston & Montana Copper and Anaconda, died recently at Palo Alto, Calif., aged 78.

Hamilton B. Wills, a mining broker who developed many mining properties in Canada, and who retired twelve years ago, died in Toronto on Nov. 10.

William Darch, until recently connected with properties at Grass Valley, Calif., was crushed to death at Silver City, Nev., in the Esther mill, early last month.

Charles E. Lawrence, until last June general superintendent on the Menominee range of Michigan for Pickands, Mather & Company, died on Nov. 10; aged 69.

Julian McCarty Little, mining engineer and actor, died, after a colorful career, at Long Branch, N. J., on Nov. 23, as a result of an automobile accident; aged 49.

Harry A. Chinn died at Virginia, Minn., on Oct. 20th; aged 56. He was associated with the Oliver Iron Mining Company for forty years and was well known throughout the Missabe range.

Murdock McDonald died at Virginia, Minn., on Nov. 11; aged 73. A specialist in diamond-drill operation, he formed the company of Cole & McDonald in 1891, which firm contracted exploratory drilling all over the world.

S. Frank Palmer, a retired mining engineer, of Madison, N. J., died recently of heart disease on a Hudson and Manhattan subway train; aged 69. He had followed mining in Australia, China, and India, and made a trip to Africa last Winter. Burial was in Denver.

Alfred J. Dunn, for twenty years editor of *The Wallace Miner,* and for almost as long a period news correspondent for Idaho for *Engineering and Mining Journal,* died at Wallace, Idaho, on Oct. 6. He was 70 years old. Mr. Dunn served in the Philippines during the Spanish-American War. For 47 years he had been a leader in civic and political affairs of the Coeur d'Alene section of Idaho.

Walter B. Devereux, retired mining and metallurgical engineer, died on Nov. 19 at San Mateo, Calif.; aged 80. Mr. Devereux installed the first hydro-electric plant in the United States and the first electric hoist ever used in a mine. He invented methods of lead smelting and for the cyanide treatment of low-grade gold ores. Prior to his retirement in 1906, Mr. Devereux had acted as consultant for many important mining companies. He was a member of the A.I.M.E., of the Iron and Steel Institute of Great Britain, and of numerous social societies and clubs.

Prince Don Gelasio Caetani, mining engineer, statesman, soldier, scientist, war hero, and author, Italian Ambassador to the United States from 1922 to 1924, died on Oct. 23 at Rome, Italy. Prince Caetani was born on March 7, 1877. His family has been illustrious among the Italian nobility for more than 1,300 years. His father was the fourteenth Duke of Sermoneta and his mother an Englishwoman, Ada Botte Wilbraham. He was a collateral descendant of two Popes: Gelasius II (1118-1119) and Bonafacius VIII (1294-1303). After taking an engineering degree at the University of Rome, in 1901, Prince Caetani continued his studies at Liége, Belgium. Coming to the United States, he entered the School of Mines of Columbia University, from which he graduated in 1903. He then went to Idaho, where he worked, incognito, as an ordinary miner, draftsman, and surveyor at the Bunker Hill & Sullivan. Later he went to Alaska, as surveyor for Alaska Treadwell, where he developed a process for washing gold, afterward establishing himself as a consulting mining engineer in San Francisco. On the outbreak of the War he was sent, as a sublieutenant, to Col de Lana, in the Dolomite Mountains, where the Austrians had an important fort and observation post. He spent months in driving a 2,000-ft. tunnel, to mine the fort, and on April 17, 1916, five tons of blasting gelatin were set off, destroying both fort and garrison. For this exploit he was promoted to a colonelcy and awarded the Military Order of Savoy. After the War Prince Caetani was elected to the Chamber of Deputies from Rome as a Nationalist—the first of the nobility to join the Fascist movement. He was also Mayor of Rome, as his father had been before him. After serving as the first Fascist Ambassador to Washington, he returned to Italy, to direct the draining of the Pontine Marshes, a large part of which was owned by the Prince's family. By 1932, 50,000 acres had been opened to cultivation—an engineering achievement of the first magnitude. The intensity of his labors is believed to have been responsible for his death. Prince Caetani had an extensive acquaintance, and enjoyed a deserved popularity, among mining engineers and mining men, and in diplomatic circles, in the United States. He had won distinction and renown not as an incident of birth, but by demonstrated ability, merit, and character. His name is assured a distinguished and enduring place of honor in the annals of his country and on the roster of the members of his profession.

Robert Mayo Catlin, mining engineer, died at Oakland, Calif., on Nov. 22; aged 81. Mr. Catlin was graduated from the University of Vermont in 1872. He then spent fifteen years as manager of various mines in Nevada, later worked with John Hays Hammond, then consultant for Cecil Rhodes in South Africa, and for 24 years was general superintendent of the New Jersey Zinc Company. He retired in 1930. He was a member of the South African Association of Engineers, the A.I.M.E., and the Mining and Metallurgical Society of America. A biographical sketch and an appreciation of Mr. Catlin's career was published in *Engineering and Mining Journal* of June 30, 1928.

AN APPRECIATION

Engineers the world over will pause for a moment when they shall have read the announcement of the death of Robert Mayo Catlin, in order to render homage to the memory of a great man, a great engineer, and, for many, of a great friend. He possessed those rare qualities of heart and intellect that attract and endear. His gentleness, his kindness and understanding, coupled with a firm character, created endless friends for him wherever he went, and his qualities of mind, his wit and resourcefulness, appealed to his colleagues in all branches of engineering. He had the gift, which is not vouchsafed to all, of real engineering sense, which makes the practice of the profession a pleasure. For him the fight with natural obstacles was enthralling and delightful. He seemed to know intuitively how to tackle them and how to turn them to his advantage, or—better said—to the support of the end he strove to achieve. He said once, "Work! Why work is doing something that one does not wish to do. Work is no longer work in the ordinary acceptance of the term when one does that which one likes to do." His achievements in the mining world are well known and have been accurately and extensively described. It is sufficient to say here that his mind was of the highest order of the inventive and creative type; that he was possessed of a quick wit which always delighted his friends; and that his genius has made for him a place in the engineering world that will long endure. As a valedictory to him and on behalf of all his friends, I would say to him, "Good-bye, Bob; and good luck to you! We shall not forget you." FRED HELLMANN.

New York, N. Y.

NEW BOOKS

Literature of Recovery

AMERICA'S HOUR OF DECISION. *By Glenn Frank. Whittlesey House, McGraw-Hill Book Company, Inc. Pp. 263. Price $2.50.*

BEYOND THE NEW DEAL. *By David Lawrence. Whittlesey House, McGraw-Hill Book Company, Inc. Pp. 321. Price $2.50.*

These two books are among the best of the many contributions to the literature of the recovery. Written from different viewpoints, they are nevertheless complementary and may well be read successively.

Dr. Frank offers no "plan" for economic recovery, which affords welcome relief, nor does he make for America a decision he regards as necessary and inevitable. He propounds the questions, discusses the competing philosophies, and contrasts the policies that have led to the crossroads where the decision must be made. There he leaves the reader, but not without having shed a brilliant light on many of America's problems in an effort to aid intelligent decision. The scope of his subject, as well as the vigor of his treatment, is indicated in such chapter titles as Democracy Flouted, Freedom Invaded, Plenty Renounced, Science Betrayed, Education Hamstrung, Religion Exiled, and Nationalism Amuck. The gist of Dr. Frank's thesis is that American life is undergoing profound change, due primarily to the impact of science, technology, and power on our social, political, and economic activities. These three factors have resulted in an economy of plenty that we have not yet learned to control for the security and satisfaction of the great mass of the people. And the challenge to leadership is to devise an economics of plenty that will spread buying power able to consume the mass production that is characteristic of an era of science, technology, and power.

Mr. Lawrence has brought to his labors for national and world well-being a trained and matured technique of interpretation and deduction. His book is fluent, forceful, and convincing. He indicts a whole nation and a whole world. He refers to the post-War decade as "an orgy of unrestrained sin." He holds that our remissions have found us out and that only in repentance and expiation is surcease of misery to be found. Observance of the Ten Commandments is advocated as appropriated to the occasion.

As a substitute for alphabetics, Mr. Lawrence urges loans at a low rate of interest to the heavy, or capital-goods, industries, so that they may scrap obsolete and worn-out equipment and produce most economically and efficiently. This is sound; for only by the attainment of the highest efficiency can wages be raised, hours of labor be reduced, and the slack in unemployment be taken up. He also demands balancing the national budget, revision of the Securities Act; a world conference on economics, to be called by the President, to create facilities for the exchange of goods and services; removal of war-debt irritations by compromise; closer Executive contact between the President and the members of his Cabinet; amendment of the Constitution to provide for the recall of Representatives and Senators; and provisions for special sessions of Congress on the demand of two-thirds of the members of the lower house. He declares that the world is an economic unit. He wants us to substitute reason for emotion. His ideal is an "unimpaired initiative" and an "unsquelched incentive."

Of the writing of books on economics there appears to be no end—fortunately. The "dismal science" has come into its own.

Arsenic and Silver

ARSENICAL AND ARGENTIFEROUS COPPER. *By J. L. Gregg. American Chemical Society Monograph Series. Published by The Chemical Catalog Company, New York. Pp. 189. Price, $4.*

In the United States arsenical and argentiferous copper is produced in the copper mines of northern Michigan, although, contrary to common belief, all copper from this region does not come under this category. Lake copper has always enjoyed an enviable reputation, and for many uses the small content of arsenic and silver offers definite advantages. Only limited space has been devoted to the geology, mining, and reduction of the Michigan ores; the main part of the book deals with the constitution and the physical properties of this copper and its alloys. Among important subjects treated may be mentioned the effect of arsenic and silver on electrical and thermal conductivity, on mechanical properties at normal and at elevated temperatures, and on the resistance to various corrosive agents.

For the Prospector

PROSPECTING FOR GOLD AND SILVER. *By Eros M. Savage. McGraw-Hill Book Company, New York. Pp. 307. Fig. 98. Operation sheets 61. Size 5x7 in.; flexible covers. Price, $2.50.*

Drawing on his training as a mining engineer and his experience as a geologist and teacher, the author has produced a book that is at once timely and instructive. The principal feature of the volume lies in its 61 operation sheets, giving condensed detailed instructions on "how to" carry out the operations that have been previously described in the text. In this manner the author segregates and summarizes essential facts and procedure in a way that leaves little opportunity for even the novice to go astray. The method is essentially that of the teacher who knows how to instruct. Written primarily for the amateur miner, the book introduces the reader successively to the elements of placer mining, mineralogy, mining law and legal procedure, surveying, use of explosives, sampling and evaluation of ore, and the buying and selling of prospects.

Mineral Data

THE MINERAL INDUSTRY, 1933. *Edited by G. A. Roush. McGraw-Hill Book Company, New York, Pp. 745. Price $12.*

This is the forty-second annual volume of a work that has long been recognized as the standard authority on statistics, technology, and trade in the mineral industries. Uniform with its predecessors in appearance and treatment, this volume gives continuity to the record and affords the reader an opportunity to trace the trends in production and price, shifts in exports and imports, changes in the international aspects of mineral control, and progress in technology. Of particular interest in this volume is record of changes in the United States resulting from NRA industrial codes and their effect on different divisions of the mineral industry. Similar interest attaches to governmental action on the price of gold and of silver and the effect on the industry.

Publications Received

Geology and Ore Deposits of Sierra County, New Mexico. By G. T. Harley. Bulletin 10, New Mexico Bureau of Mines and Mineral Resources, Socorro, N. M. Pp. 220.

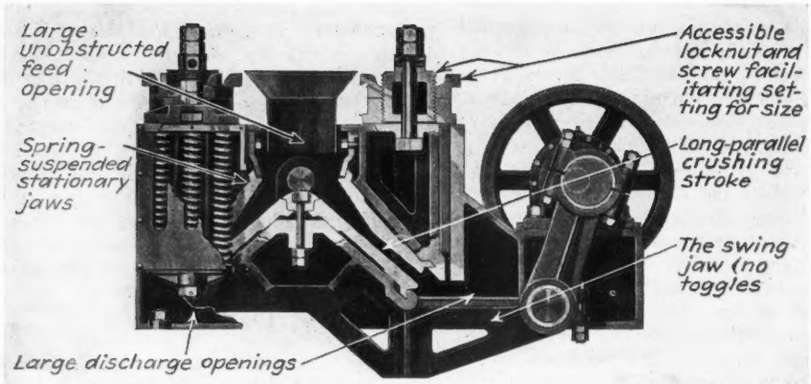
Mineral Resources of the United States, 1931. Part I, Metals. United States Bureau of Mines, Washington, D. C. For sale by Superintendent of Documents, Washington. Price, $1.50 (cloth).

Mineral Resources of the United States, 1931. Part II—Non-Metals. By O. E. Kiessling, chief economist Division of Mineral Statistics, United States Bureau of Mines. For sale by the Superintendent of Documents, Washington, D. C. Price $1 (cloth).

Placer Mining in the Western States. Part I. General Information, Hand-Shoveling, Ground Sluicing. Information Circular 6786, United States Bureau of Mines, Washington, D. C.

Hints to Prospectors (for Gold) and Owners of Treatment Plants. Published by the Government Printer, Perth, Western Australia. Sixth Edition. Pp. 58. Price 9d., postpaid in Australia.

EQUIPMENT NEWS


Large unobstructed feed opening
Spring-suspended stationary jaws
Large discharge openings
Accessible locknut and screw facilitating setting for size
Long-parallel crushing stroke
The swing jaw (no toggles

Design of New Jaw Crusher Avoids Toggles

This With Other Features Provides an Interesting Machine

Recently introduced to the mining industry, the new Eimco-Fahrenwald crusher is of the jaw or intermittent type but is a radical departure from present well-known crushers. It was deliberately developed to meet definite operating conditions. Some of the features are: (1) Protection against steel objects in the feed; (2) good reduction ratio combined with ability to do both coarse and fine reduction crushing; (3) large capacity per unit of crusher weight and jaw width; (4) uniformity of finished product; (5) provision for easy adjustment for crusher "set"; and (6) mechanical simplicity and ruggedness.

Protection against tramp steel is obtained through the spring mounting of the stationary jaw, this relieving the machine from terrific stresses to which it would otherwise be subjected. In turn this permits use of a relatively light main frame, which is a one-piece steel casting.

Passage of relatively large pieces of steel through a crusher set for fine reduction work probably of necessity demands use of relatively long swing-jaw stroke. When provided with a fine reduction head, this crusher has a stroke ranging from 1 in. for the small units up to 2 in. for the largest. When fitted with primary reduction heads, the stroke is from ½ in. to 1 in.

Successful operation of a long-stroke crusher necessitates a condition whereby the amount of reduction per stroke is much less at the throat than at the mouth and that at the mouth is only a fraction of the total stroke. This is because crusher capacity in general is related to size of product and decreases rapidly with any decrease in this size. If the capacity at the mouth is much greater than at the throat, a choked, jamming condition develops which in turn produces excess of fines as well as severe stresses in the crusher parts. These conditions are exactly met in the new crusher through use of a novel swing-jaw design, jaw suspension, and method of actuation. There are no toggles.

The swing-jaw face is set at an angle of 40 deg. with the horizontal when in closed position. It is actuated by means of a lever arm pivoted near the crusher mouth. The pivot axis is in the plane of the swing-jaw face. The jaw-arm extends considerably past the throat or discharge zone of the crusher, to give leverage, and terminates in an eye and wrist-pin. The swing-jaw arm is actuated by means of an eccentric crank and connecting rod, and there are no bearings near either jaw nor in the path of the crusher discharge. Hence, a wet feed may be used if desired.

Feed entering the crusher mouth is given a sharp crushing blow, and the resulting pieces fall by gravity, under the influence of agitation by the rapidly oscillating swing jaw, through the crushing space, receiving from eight to fifteen blows during their passage. There are from 250 to 325 strokes per minute.

The long crushing stroke results in unusual crusher capacity per unit of length of discharge mouth. For example, a 14-in. double-jaw machine with a 28-in. discharge length, handles up to 18 tons of quartz feed per hour crushing to ½ in. This is due to the freedom of flow of material between the jaws that does not obtain in short-stroke type crushers.

Two models are provided: A single-jaw type, designed for either coarse- or fine-reduction crushing; coarse and fine heads are interchangeable on the same machine; jaw plates also are reversible and interchangeable; also a double-jaw model, made with two heads for intermediate and fine reductions respectively.

The flat angle of the swing jaw, and its particular lever design, have made possible a simple and effective spring-relief mounting of the stationary jaw. The latter is held in vertical and horizontal alignment by flanges fitted into machined grooves in the main casting. It can move vertically only against two nests of coil springs neatly fitted and concealed in the main crusher frame.

Continuous Filtration Effected on an Endless Belt

Something new in continuous filtration has been introduced by the Canadian Locomotive Company, Ltd., of Kingston, Ont., in the so-called Caloco horizontal filter. The machine consists of a vacuum deck or series of stationary vacuum boxes, over which is carried a suction mat or a belt containing ports. This mat, resembling in general an endless conveyor belt, is the means by which the vacuum is carried from the vacuum boxes through the filter media to the material to be filtered.

The pulp or sludge is carried the length of the machine on a filter cloth which moves with the suction mat. At the dry end of the filter, this cloth leaves the mat, passes over a discharge pulley, discharging the cake, and then returns by means of rollers to the top of the mat at the feed end. Deckle belts form a trough which serves to hold the material on the cloth until dried to a solid cake.

According to the manufacturer, this filter is the only one in which the full effect of gravity settling is obtained. The feed is free flowing and the thickness of the discharged cake is easily regulated. At all times the filter medium is covered completely, so that no loss in capacity or vacuum occurs. One advantage of this type of filter lies in the ease with which a filter aid may be added to the pulp.

Continuous cleaning of the filter medium is possible because both sides are exposed for washing. The medium may be of any desired mesh and of any metal or textile material preferred. The suction mat is made of molded rubber, for which a long life is guaranteed, flexing being reduced to a minimum through the use of large-diameter drive and idler pulleys. Water seals along both sides of the ports also serve to lubricate the mat as it passes over the suction boxes, so that little power is required for operation.

Blasting Efficiency Improved

Greater effectiveness in blasting is said to be obtainable with the new blasting machine (known as the "Twin Fifty") developed by the Atlas Powder Company. The new unit will fire 100 electric caps at once. This increased capacity has been secured by designing a special double switch and adding a third binding post to the company's No. 3 machine, which has

ample power to fire 50 30-ft. copper-wire electric blasting caps, provided it is operated correctly and the entire blasting circuit is insulated against current leakage. The only additional equipment required is an extra leading wire. Firing of the second series follows the first so closely that the time interval between the two cannot be detected by ear.

Positive Prints for Draftsmen

A machine that makes positive prints in one operation by means of a dry developing process has been introduced by Ozalid Corporation, 354 Fourth Ave., New York. Line prints with a white background which takes pencil notations may be thus obtained. Special sensitized paper is exposed to original tracings or prints on any standard printing machine and then passed through ammonia vapor in the developing machine. Essentially, the latter consists of an ammonia vaporizing tank having a perforated top over which prints are carried by an endless belt. Electric heaters keep the temperature at 180 deg. F. in the tank. Ammonia solution is introduced through a drip feed. An air exhaust prevents the escape of ammonia fumes and thoroughly airs the prints after developing. Power consumed is about 900 watts.

A Refrigerator for Conditioning Air at Robinson Deep

The machine shown below is the first of three to be used in air conditioning the Robinson Deep mine, on the Rand, South Africa, a project described in the *E.& M.J.* for August, 1934. It weighs 100,000 lb., holds more than a ton of chemical refrigerant, and contains 1 mile of copper cooling coils. In dimensions, it is 10 ft. high, 18 ft. long, and 16 ft. wide. A 750-hp. electric motor operates it. It will produce 2,500 gal. of ice water per minute, which will be used to cool air that will then be forced into the mine at the rate of 400,000 cu.ft. per minute. It is shown assembled for shipment in the plant of the Carrier Engineering Corporation, Newark, N. J.

Recovering Placer Gold

Both fine and coarse gold as well as nuggets are said to be recovered by a new gravel-washing machine known as the Placer Miner, which has been introduced by the Williams Placer Miner Sales Company, Indianapolis, Ind. Essentially, it consists of a set of rectangular pans which are made to move by a set of eccentric cams in such a way as to effect a separation of the gold and the accompanying gravel. The feed is dumped into the hopper, where it is washed through a grizzly, the oversize going to discharge and the undersize passing into a scrubber pan, where a series of oscillating baffles disintegrate it. It then goes to screens, passing over a nugget trap en route. The screened undersize is next concentrated in a separate pan, where the concentrate is dewatered and the black sand and accompanying gold are delivered for subsequent amalgamation into a mercury chamber.

Industrial Notes

Harbison-Walker Refractories Company has acquired the American rights to the forsterite patents of Dr. Victor M. Goldschmidt, of Göttingen, Germany, and his associates. These patents, including more than a dozen issued in the United States and Canada, cover refractories made of olivine and other magnesium silicates. Forsterite melts at 1,910 deg. C. and is the only magnesium silicate which will remain stable at the temperature at which many industrial furnaces operate. Chemically, it is $2MgO:SiO_2$. It is the principal constituent compound of the more refractory olivines.

Baldwin Locomotive Works has appointed Carr Bros., Inc., of New York, as its exclusive agent for Mexico. Carr Bros. will be represented in Mexico City by P. G. Cheatham.

Schlumberger Well Surveying Corporation, Houston, Tex., has been organized to conduct the elctrical surveys and measurements of drill holes hitherto performed by the Schlumberger Electrical Prospecting organization in Texas and the Schlumberger Electrical Coring organization in California. These surveys are all made under the Schlumberger patents. Officers of the new company include C. Schlumberger, president, of Paris; M. Schlumberger, vice-president, also of Paris; and E. G. Leonardon, vice-president and treasurer.

One of three new air-conditioning units for Robinson Deep

Bulletins

Protection Against Dust. Mine Safety Appliances Co., Pittsburgh, Pa. M.S.A. Comfo respirator. Bulletin CR-1. Pp. 4.

Filtration and Filters. Filtration Equipment Corporation, Division of American Cyanamid Company, New York. Bulletin. Pp. 8.

Rod Mills. Allis-Chalmers Manufacturing Company, Milwaukee, Wis. Bulletin 1821-C. Pp. 20.

Welding, Brazing. Electric Torch Mfg. Co., 2442 San Pablo Ave., Oakland, Calif. Folder on Roffy automatic arc torch.

Steel Castings. Edgar Allen & Co., Ltd., Imperial Steel Works, Sheffield, England. Catalog C, The Steel Foundry Book. Pp. 55.

Non-clogging Centrifugal Pumps. Economy Pumping Machinery Company. Bulletin F534. Pp. 16.

Pulverizing, Air Separation. Raymond Bros. Impact Pulverizer Co., Chicago. Folder covering roller mills equipped with "Whizzer" separators, hitherto used in Raymond mechanical air separator.

Sand and Dredging Pumps. Georgia Iron Works, Augusta, Ga. Timken-equipped pump. Pp. 4.

Rotary Compressors. Fuller Company, Catasauqua, Pa. Bulletin C-3A, Single- and two-stage compressors and vacuum pumps.

Switches, Starters, Contactors. Allen Bradley Co., Milwaukee, Wis. Price sheets, being first section of General Catalog, under revision.

Non-metallic Sheathed Cable. General Cable Corp., New York, Romex cable. Pp. 8.

Heavy-duty Blowers. Roots-Connersville Blower Corp., Connersville, Ind. Bulletin 22:23-B10. Pp. 8. Also Bulletin 50-B11 on high-duty vacuum pumps.

Electric Furnaces. Detroit Electric Furnace Co., Detroit, Mich. Type GM rocking furnaces. Pp. 2.

Mine Trackwork. C. S. Card Iron Works Co., Denver, Colo. Folder.

Power Shovels. Marion Steam Shovel Co., Marion, Ohio. Issue No. 4, Vol. 8, of *The Groundhog* commemorating the company's fiftieth anniversary.

Industrial Cable. General Electric Co., Schenectady, N. Y. Publication GEA-1838. Pp. 80.

Cyanide Testing. General Engineering Co., Inc., Salt Lake City, Utah. Bulletin 3401. Pp. 4.

Furnace Roof Temperature-limit Control. Leeds & Northrup Co., Philadelphia. Bulletin 53-116. Pp. 12.

Drills. Worthington Pump & Machinery Corp., Harrison, N. J. The "Rock Master," mounted on a light mobile rig.

Air Circuit Breakers. Roller-Smith Co., New York. Catalog 5. Pp. 14.

Corrosion- and Heat-resisting Steels, Crucible Steel Co. of America, New York. General Catalog Sections. Pp. 79.

Conical Grinding Mills. Hardinge Co., York, Pa. Bulletin 13C. Pp. 56.

Prospecting Drills. Bucyrus-Erie Co., South Milwaukee, Wis. Bulletin, Models 26-P and 33-P. Pp. 24.

Ball, Rod, and Tube Mills. Patterson Foundry & Machine Co., East Liverpool, Ohio. Pp. 16.

Diesel Engines. Ingersoll-Rand Co., New York. Stationary type.

Spectrography. Bausch & Lomb Optical Co., Rochester, N. Y. The small Littrow spectrograph. Pp. 8. Also a bulletin on the Density Comparator for rapid quantitative spectrograph analysis. Pp. 4.

Crushers, Grinding Mills, Kilns. Traylor Engineering & Mfg. Co., Allentown, Pa. General Catalog. Pp. 94.

Symons Screens. Nordberg Manufacturing Co., Milwaukee, Wis. Bulletin 65. Pp. 6.

Gas Engine Fuel, Philgas Co., Detroit, Mich. Bulletin 38, entitled "A New and Better Fuel for Internal Combustion Engines." Pp. 4.

SUMMARY OF T

MONTHLY COMMENT . . . DAILY AND AVERAGE MONTHLY PR

STATISTICAL data released during the last month indicated that the low for the year in the domestic movement of copper, lead, and zinc into the hands of consumers was reached in September. Since that month the trend has been slightly upward.

Prices, influenced more by new bookings than shipments, were irregular. Domestic copper was maintained on the basis of 9c., Valley. Both lead and zinc prices declined. Tin quotations moved within narrow limits, under control of the tin group, and averaged a shade higher contrasted with the month previous.

Silver attracted interest, speculative operations in the metal again expanding, chiefly in London. The New York price on Nov. 13 was raised to 55¾c. per ounce, a new high for the movement and the highest price recorded since April 23, 1929. The Administration's program continues to be the dominating influence in the world's silver market.

Domestic sales of Blue Eagle copper during November totaled around 15,500 tons. According to a statement issued during the month, 136 consumers have signed buying agreements satisfactory to the Copper Code Authority. The list is said to cover all consumers who normally consume an average of 50 tons or more of copper a month. Nevertheless, the buying of copper has not been sufficient to absorb the "book," and, for the third time, primary producers have agreed to waive their sales quotas. Producers extended the period of restricted sales participation to the end of January, as conditions are not expected to change radically in the next two months. Moreover, producers of copper from secondary sources have been asked to curtail their intake in this period by about 25 per cent.

Copper producers with properties outside of the United States are vigorously pushing plans for "rationalizing" the world market for the metal. So far all discussions have been preliminary. The scheme, briefly, is to balance production and consumption, having higher prices as the objective. More than one important factor in the foreign market for copper would like the plan to include production control, allocation of markets, and price-fixing. Others believe that production control is all that is necessary.

The *E.&M.J.* index of non-ferrous metal prices for November was 71.07, against 70.84 in October. The rise in silver more than offset the declines in lead and zinc.

United States Market

	Electrolytic Copper			Straits Tin	Lead		Zinc
	Domestic		Export	New York	New York	St. Louis	St. Louis
Nov.	(a)	(b)	(c)				
1	9.00	8.775	6.500	51.150	3.70	3.55	3.825
2	9.00	8.775	6.475	51.150	3.70	3.55	3.800@3.825
3	9.00	8.775	6.500	51.150	3.70	3.55	3.800@3.825
5	9.00	8.775	6.500	51.125	3.65	3.50	3.750@3.800
6	Holiday		6.500	Holiday			
7	9.00	8.775	6.575	51.250	3.60	3.45	3.750
8	9.00	8.775	6.575	51.375	3.60	3.45	3.750
9	9.00	8.775	6.550	51.300	3.60	3.45	3.750
10	9.00	8.775	6.550	51.300	3.60	3.45	3.750
12	9.00	8.775	6.575	Holiday			
13	9.00	8.775	6.575	51.300	3.60	3.45	3.750
14	9.00	8.775	6.600	51.250	3.60	3.45	3.750
15	9.00	8.775	6.625	51.150	3.60	3.45	3.725@3.750
16	9.00	8.775	6.525	51.200	3.55	3.40	3.725
17	9.00	8.775	6.525	51.200	3.55	3.40	3.725
19	9.00	8.775	6.500	51.125	3.50	3.35	3.725
20	9.00	8.775	6.500	51.150	3.50	3.35	3.700@3.725
21	9.00	8.775	6.350	51.250	3.50	3.35	3.675
22	9.00	8.775	6.400	51.200	3.50	3.35	3.650@3.700
23	9.00	8.775	6.425	51.250	3.50	3.35	3.675
24	9.00	8.775	6.450	51.200	3.50	3.35	3.675
26	9.00	8.775	6.500	51.250	3.50	3.35	3.675
27	9.00	8.775	6.550	51.275	3.50	3.35	3.700
28	9.00	8.775	6.525	51.375	3.50	3.35	3.700
29	Holiday		6.500	Holiday			
30	9.00	8.775	6.475	51.250	3.50	3.35	3.700
Av. for month		8.775	6.513	51.227	3.567	3.417	3.732
Averages for Week							
7		8.775	6.508	51.165	3.670	3.520	3.795
14		8.775	6.571	51.305	3.600	3.450	3.750
21		8.775	6.504	51.179	3.533	3.383	3.717
28		8.775	6.475	51.258	3.500	3.350	3.683
Calendar Week Averages							
3		8.775	6.583	51.175	3.700	3.550	3.825
10		8.775	6.542	51.270	3.610	3.460	3.755
17		8.775	6.571	51.220	3.580	3.430	3.738
24		8.775	6.438	51.196	3.500	3.350	3.690

Silver, Gold, and Sterling Exchange New York and London

	Sterling Exchange		Silver		Gold	
		90-day	(d)			(e) United
Nov.	"Checks"	Demand"	New York	London	London	States
1	4.97750	4.98375	53.0000	23.5000	139s 10 d	$35.00
2	4.98000	4.98625	53.2500	23.6250	139s 9 d	35.00
3	4.97875	4.98500	53.0000	23.5000	139s 10 d	35.00
5	4.98875	4.99500	53.0000	23.4375	139s 6½d	35.00
6	Holiday			23.4375	139s 5½d	Holiday
7	4.99750	5.00500	53.0000	23.4375	139s 1½d	35.00
8	5.00625	5.01250	53.2500	23.5625	139s 2 d	35.00
9	4.99000	4.99875	53.5000	23.7500	139s 7½d	35.00
10	4.99125	4.99875	53.8750	24.0000	139s 6 d	35.00
12	Holiday			25.2500	139s 6 d	Holiday
13	4.99500	5.00500	55.7500	24.8750	139s ½d	35.00
14	4.99375	5.00000	55.1250	24.7500	139s 3½d	35.00
15	4.99000	4.99500	54.7500	24.7500	139s 4½d	35.00
16	4.99375	4.99875	54.6250	24.6250	139s 3 d	35.00
17	4.99000	4.99250	54.2500	24.5625	139s 3 d	35.00
19	4.98125	4.98500	54.0000	24.3125	139s 7½d	35.00
20	4.98125	4.98375	54.0000	24.2500	139s 7½d	35.00
21	4.98750	4.99000	54.5000	24.4375	139s 5½d	35.00
22	4.99125	4.99500	54.8750	24.5625	139s 2 d	35.00
23	4.99125	4.99500	55.1250	24.5625	139s 4 d	35.00
24	4.99000	4.99250	54.7500	24.4375	139s 5 d	35.00
26	4.98625	4.98875	54.8750	24.5000	139s 6 d	35.00
27	4.98750	4.99125	55.1250	24.6250	139s 4 d	35.00
28	4.98500	4.98750	55.2500	24.6250	139s 7½d	35.00
29	Holiday			24.6875	139s 6 d	Holiday
30	4.97750	4.98125	55.0000	24.6250	139s 8½d	35.00
Av. for month	4.98832	.....	54.255	24.257	.....	35.00
Averages for Week						
7	4.98450	.....	53.050	.....	.....	.....
14	4.99525	.....	54.300	.....	.....	.....
21	4.98729	.....	54.354	.....	.....	.....
28	4.98854	.....	55.000	.....	.....	.....

Calendar week averages: New York Silver Nov. 3rd, 52.979; 10th 53.325; 17th, 54.900; 24th, 54.542.

(a) Quotation issued by the Code Authority for copper offered for sale in the domestic market pursuant to the provisions of the Copper Code.

(b) Net prices at refineries on the Atlantic seaboard, being Code Authority prices, less delivery and interest charges of 0.225c. per lb. which is the average differential for delivery in New England.

(c) Export quotations for copper are net prices at refineries on the Atlantic seaboard and include sales of domestic copper in the foreign market. The c.i.f. Hamburg, Havre, and Liverpool basis commands a premium of 0.300c. per pound above our f.o.b. refinery quotation.

Excepting "Blue Eagle" copper, the above quotations are our appraisal of the major United States markets, based on sales reported by producers and agencies. All prices are in cents per pound.

Copper, lead and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

Quotations for copper are for the ordinary forms of wirebars and ingot bars. Discount on cathodes 0.125c.

Quotations for zinc are for ordinary Prime Western brands. Zinc in New York is quoted at 0.35c. per pound above St. Louis, this being the freight differential. Contract prices for High-Grade zinc delivered in the East and Middle West in nearly all instances command a premium of 1c. per pound over the current market for Prime Western but not less than the *E. & M. J* average for Prime Western for the previous month.

Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

(d) Silver other than newly mined domestic: Under Executive order issued Dec. 31, 1933, the U. S. Government price on newly mined domestic silver was established at 64¼c. per troy ounce.

(e) U. S. Treasury's gold price.

THE MARKETS

PRICES OF METALS . . . MISCELLANEOUS QUOTATIONS

London Market

Nov.	Copper Standard Spot	Copper Standard 3M	Copper Electrolytic Bid	Tin Spot	Tin 3M	Lead Spot	Lead 3M	Zinc Spot	Zinc 3M
1	27.2500	27.5625	30.0000	229.1250	228.5000	10.5000	10.7500	12.5625	12.8125
2	27.2500	27.5625	30.0000	229.0000	228.5000	10.3125	10.6250	12.3125	12.5625
5	26.9375	27.2500	29.5000	228.8750	228.5000	10.3125	10.5625	12.3125	12.5625
6	27.5000	27.8125	30.5000	228.6250	228.5000	10.3125	10.5625	12.3750	12.6250
7	27.5625	27.8750	30.5000	228.3750	228.5000	10.2500	10.5625	12.2500	12.5000
8	27.2500	27.5625	30.5000	228.3750	228.7500	10.2500	10.5000	12.1875	12.4375
9	27.1250	27.4375	30.0000	229.1250	229.2500	10.1875	10.4375	11.8750	12.1875
12	27.3125	27.6250	30.0000	228.5000	228.7500	10.2500	10.5000	11.8750	12.2500
13	27.2500	27.6250	30.0000	228.3750	228.5000	10.2500	10.5000	11.9375	12.3125
14	27.5000	27.8750	30.7500	228.2500	228.6250	10.3125	10.6250	11.8750	12.1875
15	27.8750	28.1875	30.5000	228.2500	228.5000	10.4375	10.6875	12.0625	12.3125
16	27.0000	27.3750	30.2500	228.2500	228.6250	10.3125	10.5625	11.9375	12.1875
19	27.3125	27.6250	30.5000	228.3750	228.5000	10.4375	10.6250	11.8125	12.1250
20	27.3125	27.6250	30.5000	228.6250	228.7500	10.5000	10.6250	11.8125	12.1250
21	26.5625	26.9375	29.7500	228.5000	228.7500	10.4375	10.5000	11.8125	12.0625
22	26.6875	27.0625	29.8750	228.1250	228.5000	10.5000	10.5000	11.8125	12.0000
23	27.0000	27.3125	30.0000	228.2500	228.5000	10.5625	10.5625	11.6875	11.9375
26	27.1250	27.5000	30.0000	228.6250	228.8750	10.5625	10.6250	11.8125	12.1250
27	27.5000	27.8750	30.5000	228.7500	229.0000	10.6875	10.7500	11.8750	12.1875
28	27.5000	27.8125	30.5000	229.7500	229.7500	10.7500	10.6875	11.9375	12.2500
29	27.1875	27.5625	30.5000	228.6250	229.0000	10.6875	10.6875	11.9375	12.2500
30	27.1250	27.4375	30.2500	228.5000	228.8750	10.6875	10.6875	11.9375	12.1875
Av. for month	27.233	.....	30.222	228.602	.....	10.432	10.597	12.000	12.281

Current Prices—Miscellaneous Metals, Ores, and Non-Metallic Minerals

Quotations cover wholesale lots, prompt shipment, f.o.b. New York, unless otherwise stated.

(Dec. 1, 1934)

Miscellaneous Metals

Aluminum, ingot, 99 per cent plus, lb.	23.30c.
Antimony, domestic and Chinese (duty paid), lb.	13½@14c.
Bismuth, ton lots, lb.	$1.10
Cadmium, lb.	55.00c.
Chromium, 97 per cent grade, lb.	88.00c
Nickel, electrolytic cathodes, lb	35.00c.
Magnesium, 99.8 per cent, carloads, lb.	30.00c.
Palladium, troy oz.	$24.00
Platinum, (official quotation) troy oz.	$35.00
Quicksilver, flask of 76 lb	$72.50@$73.50
Radium, mg. radium content	$50.00
Selenium, 99.5 per cent, lb.	$2.00
Silicon, minimum 97 per cent spot, lb.	16.50c.
Tellurium, lb.	$2.00
Thallium, 100 lb. or more, lb.	$6.50
Titanium, 96 to 98 per cent, lb.	$6.00
Zirconium, commercially pure, lb.	$7.00

Metallic Ores

Beryllium Ore, f.o.b. mines, ton	$30.00@$35.00
Chrome Ore, 45@47 per cent, c.i.f., long ton	$16.00@$16.50
Iron Ore, Lake Superior, long ton:	
Old Range bessemer	$4.80
Mesabi, bessemer	$4.65
Old Range, non-bessemer	$4.65
Mesabi, non-bessemer	$4.50
Lead (Galena) 80 per cent, Joplin, Mo., ton	$32.00
Manganese Ore, long ton unit:	
52@55 per cent	26c.
49@51 per cent	25c.
44@47 per cent	24c.
Molybdenum Ore, per lb. of contained MoS_2	42c.
Tungsten Ore, per unit of WO_3:	
Chinese duty paid	$17.00
Domestic Scheelite	$16.50
Vanadium Ore, per lb. of contained V_2O_5	26c.
Zinc Ore, Prime, 60 per cent concentrate, Joplin, Mo.; per ton.	$25.00

Metallic Compounds

Arsenious Oxide (arsenic) lb.	3½c.
Cobalt Oxide, 70@71 per cent, lb.	$1.35
Copper Sulphate, 100 lb.	$3.85
Sodium Nitrate, ex vessel, in 200-lb. bags, per 100 lb.	$1.24
Sodium Sulphate, bulk ton	$13.00@$15.00

Alloys

Beryllium-Copper, Master alloy, 3.5 per cent Be, per lb. of contained Be	$25.00
Ferrochrome, 65@70 per cent chromium, 4@6 per cent carbon, lb.	10c.
Ferromanganese, 78@82 per cent, gross ton	$85.00
Ferromolybdenum, 50@60 per cent Mo, lb. of Mo contained	95c
Ferrosilicon, 50 per cent, gross ton	$77.50
Ferrotungsten, 75@80 per cent, lb. of W contained	$1.35@$1.45

Non-Metallic Minerals

Asbestos, f.o.b. mines, ton:	
Canadian (Quebec)	
Crude No. 1	$450@.....
Crude No. 2	$200@$225
Spinning fibers	$90@$135
Paper stock	$32@ $37
Shorts	$11@ $15
Vermont	
Shingle stock	$45@.....
Paper stock	$35@.....
Cement stock	$23@.....
Barytes, long ton:	
Georgia, crude	$7@.....
Missouri, 95 per cent $BaSO_4$, 1 per cent iron	$5@.....
Bauxite, long ton:	
Domestic, chemical, 55@58 per cent	$6@ $7.50
Domestic, abrasive, 78@84 per cent	$12.50@$15.00
Dalmatian, 50@55 per cent	(a)$4.50@ $6.00
French, 56@59 per cent	(a)$5.50@ $6.50
China Clay, f.o.b. mines, ton:	
South Carolina and Georgia, bulk	$6.00@ $7.50
Delaware, No. 1	$14.00@.....
Feldspar, bulk, ton:	
Potash feldspar, 200 mesh	$17.00
Glass-spar, white, 20 mesh	$11.50
Fluorspar, f.o.b. mines, bulk, Kentucky and Illinois 85-5 per cent, all rail movement, ton	@$16.00
Fuller's earth, f.o.b. Georgia or Florida, ton	$7.00@$14.00
Magnesite, per ton:	
Dead-burned, f.o.b. California	$25.00@.....
Dead-burned, f.o.b. Washington	$22.00@.....
Mica, per lb., North Carolina, No. 1 and 2 quality:	
1½x2 in.	15@30c.
2x2 in.	30@50c.
2x3 in.	50@65c.
3x4 in.	90@ $1.25
4x6 in.	$1.50@ $2.50
White, ground, 70 mesh, ton	$60.00@$80.00
Ocher, Georgia, ton	$19.00@$22.50
Pyrites, Spanish, per long ton unit of S, c.i.f. Atlantic ports	(a) 12@ 12½c
Silica, water-floated, in bags, 325 mesh, ton	$16.00@$40.00
Sulphur, Texas mines, long ton	$18.00@.....
Talc, f.o.b. works, ton:	
New York, double air-floated, 325 mesh	$12.00@$15.00
New Jersey, mineral pulp	$8.00@$10.00
Vermont, extra white, 200 mesh	$8.50@ $9.00
Tripoli, Missouri, ton:	
40 mesh, cream colored	$16.00@.....
200 mesh, cream colored	$26.00@.....

(a) Nominal.

Iron and Steel

Pig Iron, Valley furnaces, gross ton:	
Bessemer	$19.00
Basic	$18.00
No. 2 Foundry	$18.50
Steel, base prices, Pittsburgh:	
Billets and Sheet bars, gross ton	$27.00
Structural shapes, 100 lb.	$1.80
Bars, 100 lb.	$1.80

MONTHLY AND YEARLY AVERAGE PRICES

Silver and Sterling Exchange

	New York		London Spot		Sterling Exchange	
	1933	1934	1933	1934	1933	1934
January	25.400	44.188	16.883	19.382	336.060	504.644
February	26.074	45.233	16.885	20.073	342.114	503.085
March	27.928	45.875	17.588	20.278	343.138	509.259
April	30.730	45.180	18.440	19.740	357.565	515.210
May	34.072	44.226	19.046	19.276	393.106	510.510
June	35.663	45.173	19.078	19.981	413.216	504.721
July	37.630	46.310	18.341	20.512	464.760	503.990
August	36.074	48.986	17.877	21.377	449.944	506.398
September	38.440	49.484	18.272	21.888	466.240	499.344
October	38.190	52.375	18.221	23.581	466.380	494.019
November	42.974	54.255	18.428	24.257	514.573	498.832
December	43.550		18.674		511.260	
Year	34.727		18.144		421.530	

New York quotations for silver not eligible for sale to U. S. Government, cents per ounce troy, 999 fine. London, pence per ounce, sterling silver, 925 fine. Sterling exchange in cents.

Copper

	F.O.B. Refinery			London Spot			
	Electrolytic					(a)	
	Domestic		Export	Standard		Electrolytic	
	1933	1934	1934	1933	1934	1933	1934
January	4.775	7.890	7.831	28.557	32.560	33.244	35.614
February	4.775	7.777	7.844	28.481	33.072	32.556	35.969
March	5.011	7.775	7.837	28.179	32.497	32.370	35.512
April	5.395	8.173	8.053	29.576	33.006	33.681	36.038
May	6.698	8.275	7.913	34.071	32.662	38.163	35.756
June	7.773	8.594	7.705	36.759	32.149	41.000	35.339
July	8.635	8.775	7.146	37.917	29.707	41.524	32.778
August	8.768	8.775	6.885	36.071	28.358	40.227	31.483
September	8.753	8.775	6.586	35.122	27.541	38.339	30.556
October	7.950	8.775	6.315	33.656	26.753	36.977	29.478
November	7.881	8.775	6.513	30.588	27.233	33.898	30.222
December	7.885			31.306		34.329	
Year	7.025			32.524		36.359	

New York quotations, cents per pound. London, pounds sterling per long ton.
(a) Bid quotation.

Lead

	New York		St. Louis		London			
	1933	1934	1933	1934	1933 Spot	1933 3 Mos.	1934 Spot	1934 3 Mos.
January	3.000	4.000	2.875	3.900	10.458	10.833	11.304	11.517
February	3.000	4.000	2.875	3.900	10.431	10.719	11.634	11.913
March	3.146	4.000	3.021	3.900	10.609	10.821	11.545	11.842
April	3.260	4.179	3.135	4.042	10.872	11.122	11.500	11.794
May	3.654	4.140	3.525	3.990	12.095	12.372	11.051	11.341
June	4.173	3.975	4.023	3.825	13.280	13.571	11.054	11.253
July	4.452	3.772	4.303	3.623	13.411	13.613	10.813	11.045
August	4.500	3.747	4.350	3.597	12.182	12.457	10.821	11.028
September	4.500	3.685	4.350	3.535	11.932	12.229	10.388	10.613
October	4.313	3.654	4.176	3.504	11.804	12.102	10.359	10.554
November	4.288	3.567	4.146	3.417	11.537	11.778	10.432	10.597
December	4.141		4.042		11.431	11.658		
Year	3.869		3.735		11.670	11.940		

New York and St. Louis quotations, cents per pound. London, pounds sterling per long ton.

Tin

	New York		London	
	1933	1934	1933	1934
	Straits		Standard, Spot	
January	22.692	51.891	145.708	226.631
February	23.500	51.668	148.544	226.731
March	24.221	53.838	149.120	233.863
April	27.136	55.622	157.944	239.181
May	36.051	53.541	186.207	234.239
June	44.097	51.271	219.964	226.875
July	46.356	51.930	216.673	230.381
August	44.794	51.953	215.210	228.114
September	46.665	51.503	216.893	229.888
October	47.858	50.951	223.455	230.587
November	53.011	51.227	226.722	228.602
December	52.936		227.678	
Year	39.110		194.510	

New York quotations, cents per pound. London, pounds sterling per ong ton.

Zinc

	St. Louis		London			
	1933	1934	1933 Spot	1933 3 Mos.	1934 Spot	1934 3 Mos.
January	3.018	4.271	14.381	14.595	14.688	14 943
February	2.666	4.384	13.866	14.119	14.844	15.125
March	2.987	4.368	14.647	14.674	14.735	15.033
April	3.298	4.370	14.951	15.208	14.916	15.200
May	3.805	4.346	15.505	15.660	14.722	14.966
June	4.348	4.240	16.988	16.774	14.241	14.467
July	4.878	4.317	17.795	17.789	13.466	13.693
August	4.916	4.281	16.869	17.031	13.682	13.756
September	4.699	4.049	16.810	17.042	12.644	12.847
October	4.748	3.832	16.310	16.599	12.217	12.353
November	4.520	3.732	15.048	15.349	12.000	12.281
December	4.461		14.826	15.059		
Year	4.029		15.666	15.825		

St. Louis quotations, cents per pound. London, pounds sterling per long ton.

Cadmium and Aluminum

	Cadmium		Aluminum	
	1933	1934	1933	1934
January	55.000	55.000	23.300	23.300
February	55.000	55.000	23.300	23.300
March	55.000	55.000	23.300	23.300
April	55.000	55.000	23.300	23.300
May	55.000	55.000	23.300	23.300
June	55.000	55.000	23.300	23.300
July	55.000	55.000	23.300	23.300
August	55.000	55.000	23.300	23.300
September	55.000	55.000	23.300	23.300
October	55.000	55.000	23.300	23.300
November	55.000	55.000	23.300	23.300
December	55.000		23.300	
Year	55.000		23.300	

Aluminum in cents per pound, 99 per cent grade.
Cadmium, cents per pound.

Antimony, Quicksilver, and Platinum

	Antimony (a) New York		Quicksilver (b) New York		Platinum (c) New York	
	1933	1934	1933	1934	1933	1934
January	5.722	7.198	48.500	67.538	26.480	38.000
February	5.738	7.172	48.614	72.011	24.000	38.000
March	5.901	7.545	52.676	75.472	24.667	38.000
April	5.876	7.918	54.580	75.930	26.800	38.000
May	6.264	8.465	56.500	75.577	28.500	36.538
June	6.500	7.900	60.038	75.000	30.000	36.000
July	7.262	8.024	62.900	75.000	32.320	36.000
August	6.986	8.514	63.500	75.000	33.000	36.000
September	6.880	8.745	64.580	74.563	34.560	36.000
October	6.843	9.361	66.500	74.000	36.000	35.038
November	7.113	12.239	66.000	73.283	37.583	35.000
December	7.250		66.330		38.000	
Year	6.528		59.227		30.993	

(a) Antimony quotations in cents per pound, for ordinary brands. (b) Quicksilver in dollars per flask of 76 lb. (c) Platinum in dollars per ounce troy.

Pig Iron

	Bessemer		Basic		No. 2 Foundry	
	1933	1934	1933	1934	1933	1934
January	14.50	18.00	14.00	17.00	14.50	17.50
February	14.50	18.00	14.00	17.00	14.50	17.50
March	14.50	18.00	14.00	17.00	14.50	17.50
April	14.50	18.48	14.00	17.48	14.50	17.98
May	15.42	19.00	14.42	18.00	14.92	18.50
June	16.00	19.00	15.00	18.00	15.50	18.50
July	16.50	19.00	15.50	18.00	16.00	18.50
August	17.00	19.00	16.00	18.00	16.50	18.50
September	18.00	19.00	17.00	18.00	17.50	18.50
October	18.00	19.00	17.00	18.00	17.50	18.50
November	18.00	19.00	17.00	18.00	17.50	18.50
December	18.00		17.00		17.50	
Year	16.24		15.41		15.91	

Iron in dollars per long ton. F.o.b. Mahoning and Shenango Valley furnaces.

Used in the production of a very large percentage of the world's output

of GOLD
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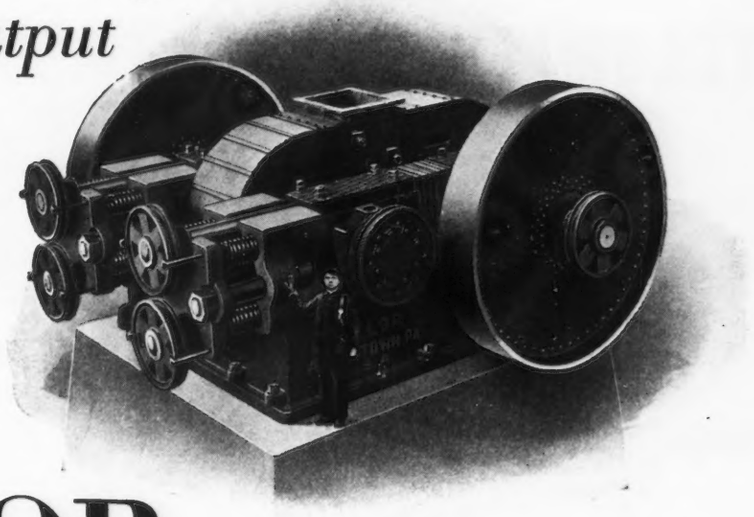

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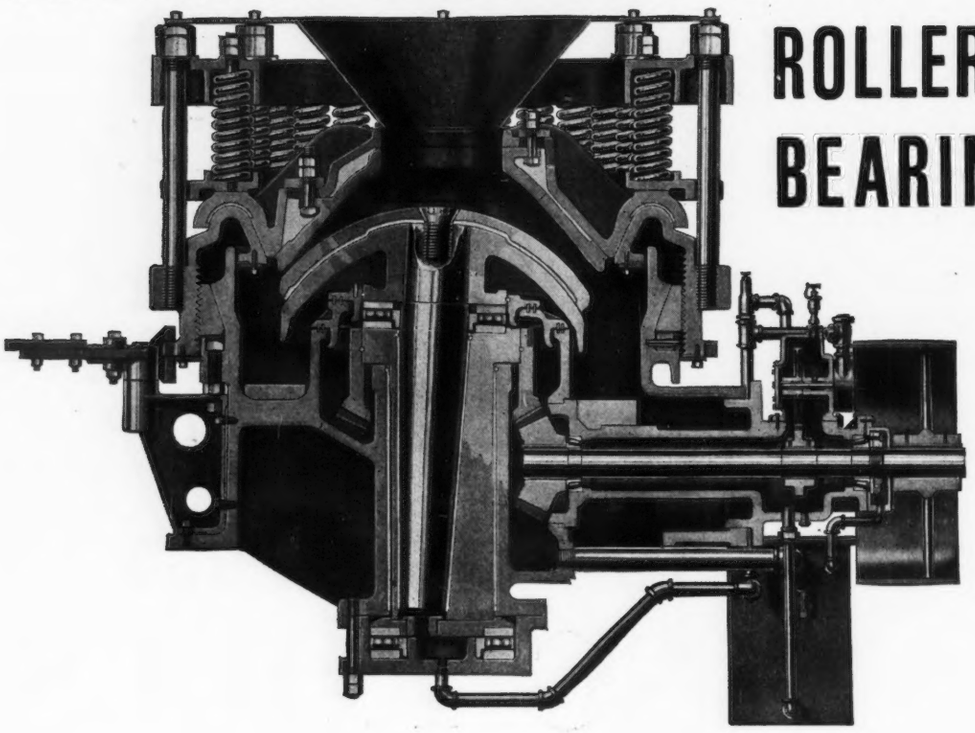
European Works—Usines Carels Freres, Ghent, Belgium.

Why IS THE TELSMITH GYRASPHERE EQUIPPED WITH ROLLER THRUST BEARINGS?



In any type of crusher, the load is determined by the hardness of the rock, the volume of the feed and the ratio of reduction. The designing engineer can't reduce the work. He can only distribute it to the best advantage.

In the Telsmith Gyrasphere, the spherical shape of the head throws an unusual proportion of the load downward, to the bottom thrust bearing. This is as it should be. There is no bearing that will stand such heavy pressure and high speed as a roller thrust bearing. No bearing is so easy to lubricate. No bearing is so economical of power, so dependable under heavy duty. All of which has been amply demonstrated by the performance of roller step bearings in hydraulic turbines. Obviously then, this new distribution of pressures in the Telsmith Gyrasphere is a feature of major advantage, reducing the load on the shaft and eccentric.

But that's not all the story. The head and its dependent shaft are both supported on the eccentric, by means of a second roller thrust bearing. As bearing rotates, the wear is uniform and the supporting surface is always true. There is no stationary surface to wear unequally—to shift the load to some unexpected point. The head and shaft unit are always perfectly aligned—shaft breakages are eliminated, eccentric bearings last longer, lubrication is simplified and dirt is easily excluded from the oil-stream.

Result—when the user adds up his power and repair bills, HE KNOWS why the Telsmith Gyrasphere is equipped with roller thrust bearings. Write for Bulletin Y-1.

Cable Addresses: Sengworks, Milwaukee . Concrete, London.
EXPORT OFFICE: 770-A-Hudson Terminal Bldg., New York

50 Church St. New York City	211 W. Wacker Drive Chicago, Ill.	130 S. 15th St. Philadelphia, Pa.
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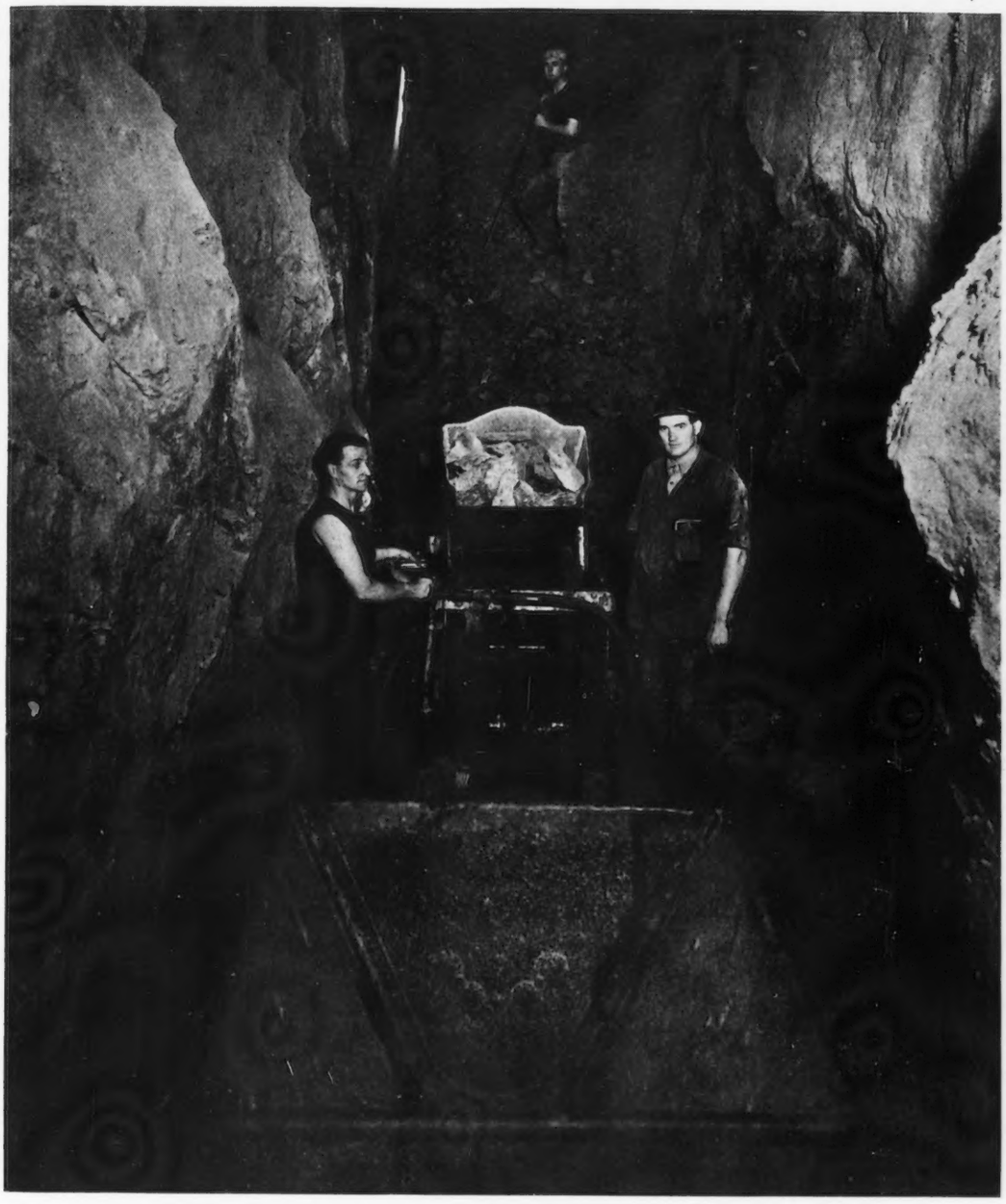
502 East Capitol Drive Milwaukee, Wis.

TELSMITH

EIMCO-FINLAY LOADERS

At one of Australia's great mines



One of three Eimco-Finlay loaders in operation at the mines of Lake View & Star, Ltd., Kalgoorlie, Australia.

In all parts of the world where able management is ever on the lookout for cost-saving in the handling of muck and ore the EIMCO-FINLAY LOADER is being widely used. Write for detailed information for you too will want to join the fast growing ranks of users.

EIMCO

AGENTS:
Coeur d'Alene Hardware & Fdry. Co., Wallace, Ida.
H. W. Foester Mills Building, El Paso, Texas
E. Long, Ltd., Orillia, Canada
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B. C. Equipment Company, Vancouver, B. C.
Hodgson & Cranston, Kalgoorlie, Australia
International Machinery Company, Rio de Janeiro

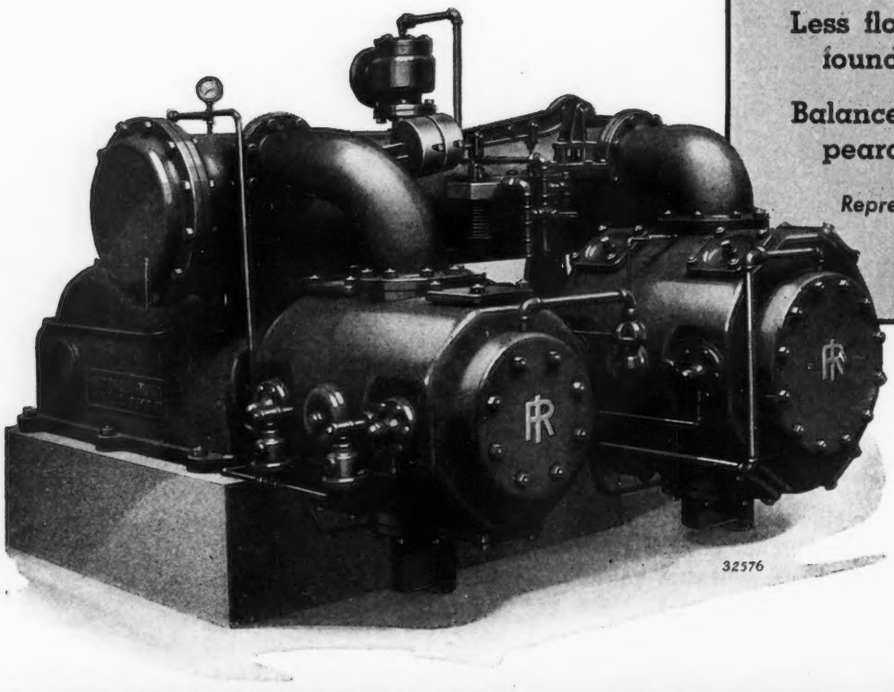
Eastern Iron & Metal Company, Inc. 634 South Fourth West Street, Salt Lake City, Utah, U. S. A.

MODERN I-R AIR AND GAS COMPRESSORS GREATLY REDUCE POWER COSTS

An old, inefficient compressor is generally dissipating dollars at every stroke. You may not see this loss, but it is there just the same.

A new machine will often pay for itself from one to two years' time. Our engineers will be glad to check your air power costs. You may be amazed at the savings you can make by installing a modern compressor.

There are over 1000 sizes and types of compressors in the I-R line from which you may select a machine just right for your conditions.



FEATURES WHICH MAKE FOR REDUCED POWER CONSUMPTION AND LOWER INSTALLATION AND MAINTENANCE COSTS

Improved valving in the air end • • • • •

Better cooling of cylinders •

Simple and reliable capacity regulation in "steps" down to the smallest sizes • •

Improved intercooler construction • • • • •

More liberal bearing areas combined with a simple and efficient lubricating system •

Greater compactness • •

Less floor space and smaller foundations • • • •

Balanced design, better appearance • • • •

Representatives the world over

88-1

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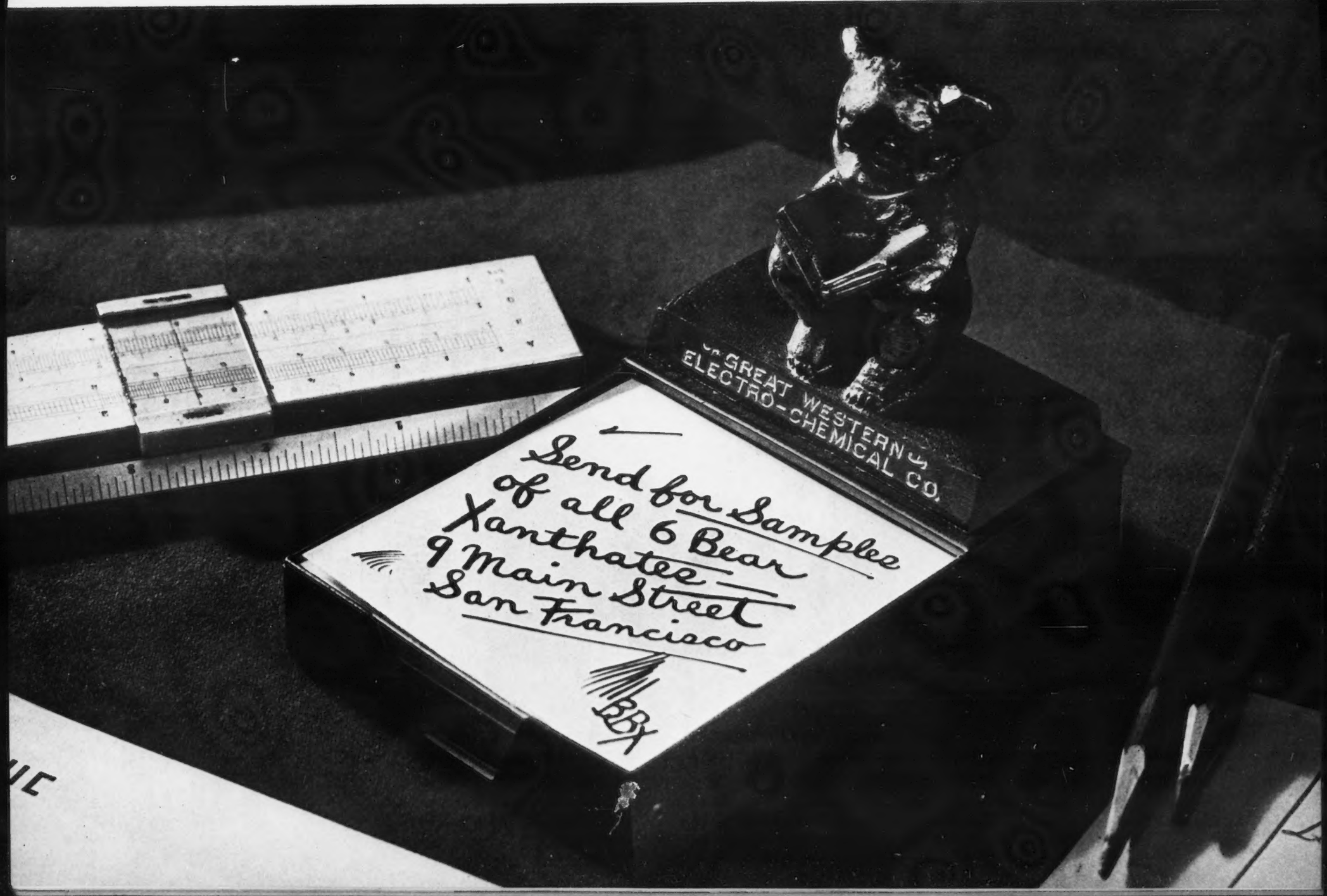
GREAT WESTERN
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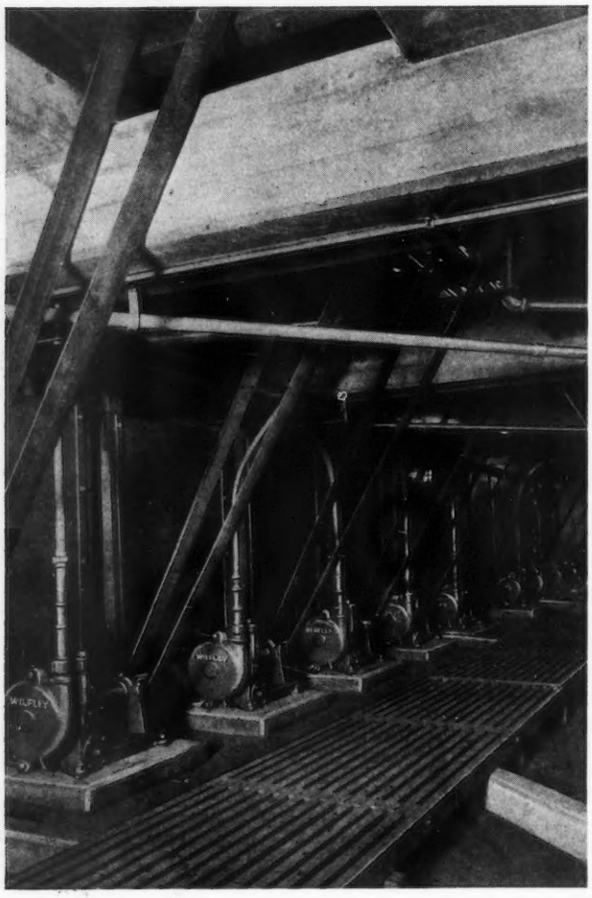
Let the WILFLEY SAND PUMP *help* STOP RISING COSTS



ON the operating side, three special features stand out as particularly useful in this connection: the unique clearance take-up whereby the capacity can be easily maintained throughout the life of the pumping parts; the extra material hence extra life placed in these parts; and the elimination of high pressure gland water.

On the maintenance side, there are also three features which help to make this pump so popular: the absence of any stuffing box; the 10 to 15 minute change of pumping parts; and the protection given the inner parts of the pump.

The record of the thousands of Wilfley Pumps already in service in cyanide and concentrating mills the world over is one of consistently low cost handling of slimes and sands.

Sole Licensees and Manufacturers

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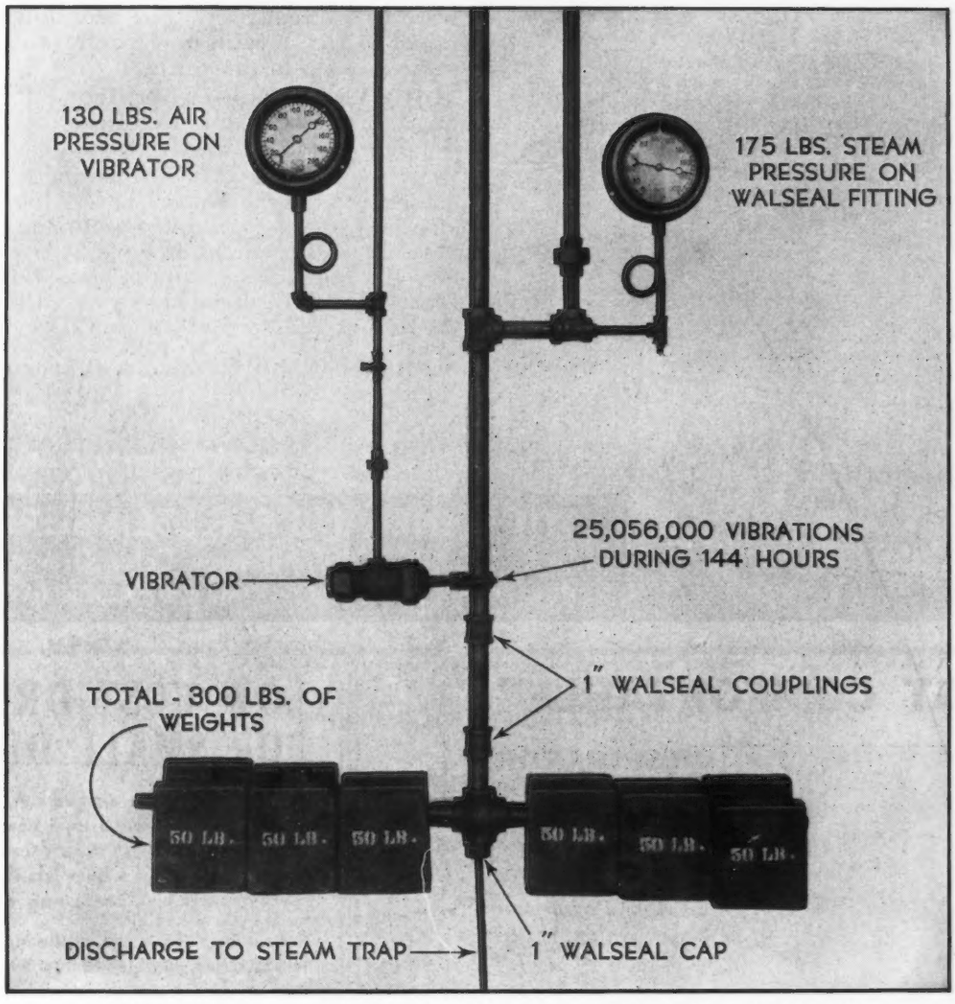
CENTRIFUGAL WILFLEY PUMPS
Reg. U. S. Pat. Off.

Sizes 1" to 8" Belt or Direct Drive

A. R. WILFLEY and SONS, Inc.
Denver, Colorado, U. S. A.
NEW YORK OFFICE, 1775 BROADWAY, NEW YORK, N. Y.

WILFLEY
centrifugal SAND PUMPS
PATENTED

"WE KNOW OF NO BRONZE FITTING OTHER THAN *WALSEAL THAT CAN WITHSTAND THESE CONDITIONS"



Walseal Fittings are available in sizes ¼" to 8" — Walseal Flanges 1½" to 12"

The operating conditions given above namely —

175 lbs. Steam Pressure...25,056,000 vibrations in 144 hours with 300 lbs. of weights directly suspended on a Walseal cap.

—is an unusual combination but not too severe for Walseal. After completing this test the assembly was tested to 600 lbs. hydraulic pressure and was found perfectly tight. The Fittings used were standard weight Walseal Fittings taken from stock.

* *Reg. U. S. Pat. Off.*

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VALVES FITTINGS and TOOLS
Backed by 91 Years' Service

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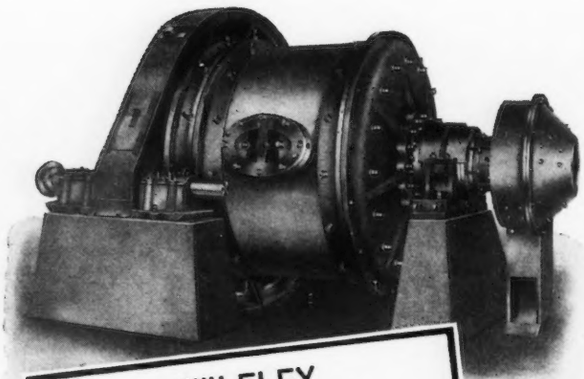
MARCY Ball Mills

STILL THE STANDARD AFTER TWENTY YEARS



THE development of the original MARCY Ball Mill twenty years ago marked an important step forward in ore reduction. The adoption and continued use of MARCY Mills now extends to every important mining camp in the world.

MARCY Mills have a wide adaptability for wet grinding of ores preparatory to concentration, cyanidation, flotation, leaching, amalgamation, etc.

Present day MARCY Mills embody important engineering improvements. These, together with outstanding quality of workmanship and material, have won the endorsement of engineers who know them. Are you familiar with the 18 sizes? Do you know *how* Marcy Ball Mills have kept pace with the progress of the mining industry? If you don't, we'd like to tell you.

MARCY Ball Mill Catalog sent promptly on request

WILFLEY
Concentrating Tables
Adams Reagent Feeders
Laboratory Equipment

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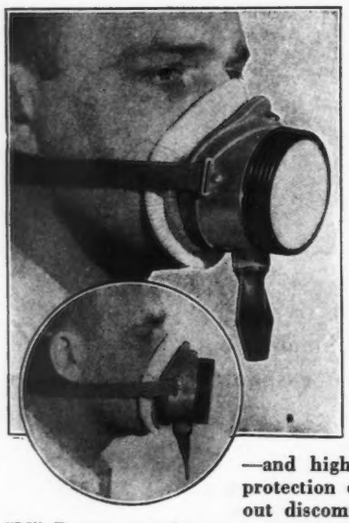
"MOST COMFORTABLE" RESPIRATOR ever built!"



. . . say miners of the Pulmosan "M" Respirators.

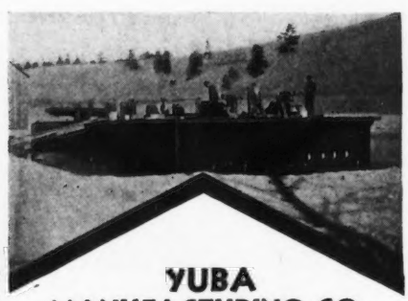
And no wonder! The "M" Respirators are designed by mining experts for miners' use. They have many exclusive features that assure utmost wearing comfort—easy, natural breathing—perfect fit —and highest safety. They give protection over long periods without discomfort or fatigue. Order "M" Respirators for your miners and know they are safe. Write for Bulletin No. 8, for details.

PULMOSAN SAFETY EQUIPMENT CORP.
176 Johnson St., Brooklyn, N. Y.

PULMOSAN *"M" Type*
DUST RESPIRATORS

LOW COST DREDGING FOR SMALL DEPOSITS

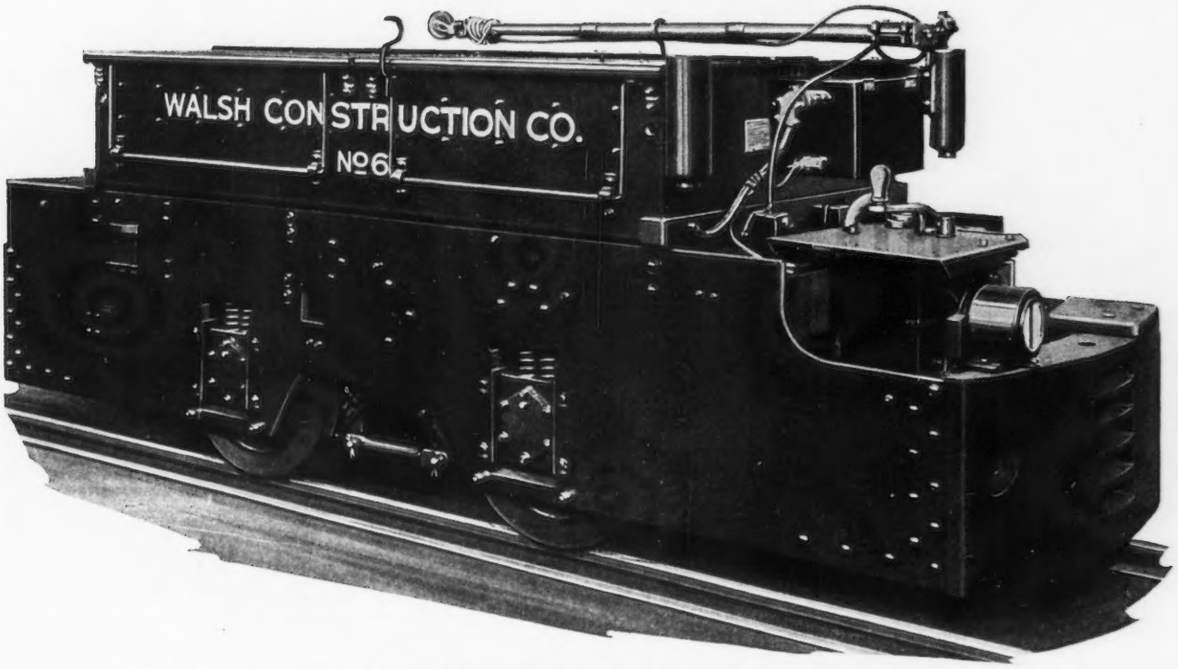
- When the area is worked out, the Yuba Jr. is dismantled and moved to a new location. It is as portable as a 5-ton truck. Completely sectionalized — each part weighs less than 5 tons and is readily reassembled on the new job.
- And the Yuba Jr. is a full-fledged Yuba in everything but size. Developed from 30 years' specialization on dredge design and manufacture the Yuba Jr. meets field requirements for a Yuba-quality dredge for small deposits.
- With low-first cost, economical operation, high yardage — the Yuba Jr. will make profits for you. Let our engineers analyze your problems.



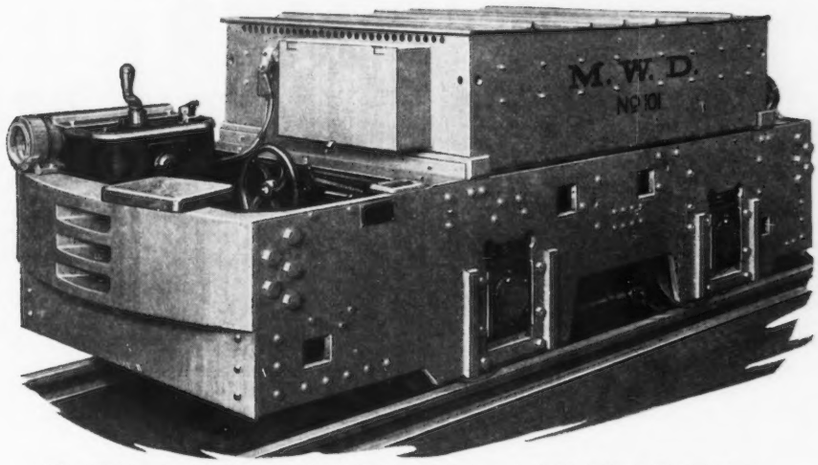
JR.
YUBA

YUBA MANUFACTURING CO.
351 California St., San Francisco, Calif., U.S.A.

For Severe Haulage Conditions— Choose Goodman Locomotives



The Walsh Construction Company's locomotives are Combination Battery and Trolley locomotives, with provision made to charge battery when operating on trolley.



The Metropolitan Water District's locomotives are straight battery locomotives.

The two locomotives illustrated above are part of a fleet of 44 Goodman locomotives purchased for use in the construction of the Metropolitan Water District tunnels in Southern California and the diversion tunnels on the Fort Peck Project in Montana. These 44 locomotives are working three shifts per 24 hours and 7 days per week.

GOODMAN MANUFACTURING COMPANY
HALSTED ST. at 48TH.
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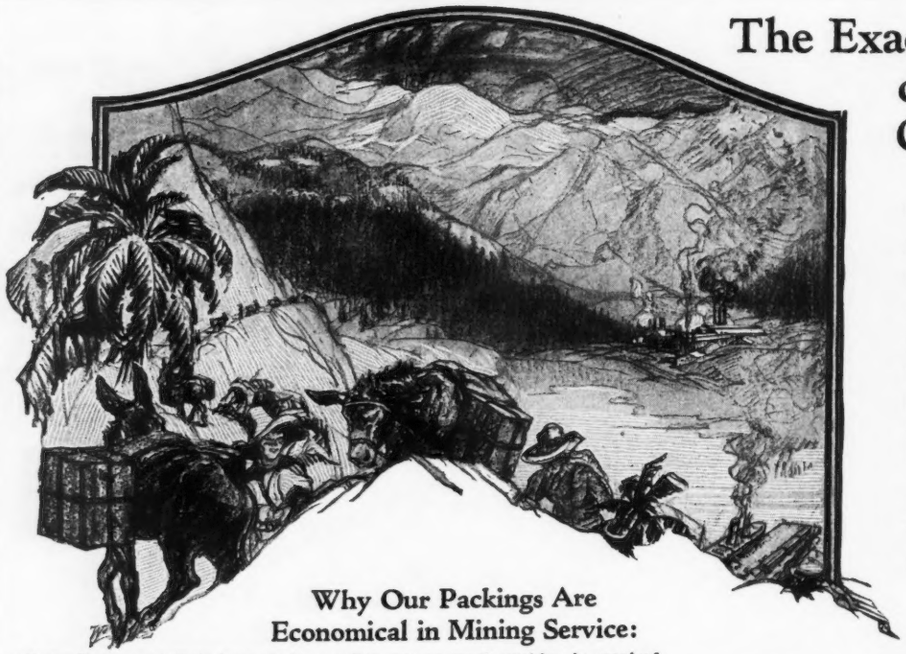
Locomotives - Loaders - Coal Cutters

PITTSBURGH-WILKES-BARRE-HUNTINGTON-BIRMINGHAM-ST LOUIS-DENVER-LOS ANGELES



The Exacting Demands of MINING OPERATIONS

demand packings that give long service—because mining camps are usually located at points remote from sources of supply, the transportation of which is long and expensive. Therefore, it is important that the packing used is not affected by time and climate.

Why Our Packings Are Economical in Mining Service:

First—Because of their long-service quality, not so much packing is required.
Second—Lasting quality, due to their containing no rubber or materials that are affected by climate or age.
Third—The frictionless quality of the packings, due to a more thorough system of lubrication than ordinary packings possess.
"PALMETTO" Packing has no equal under Steam and Compressed Air.
"PALCO" Packing, for pumps handling Hot and Cold Water.
We have special packings for Sulphuric and Nitric Acids, Caustic Soda, Alkalis, Etc. Send for a chart, designating best packing for each service.

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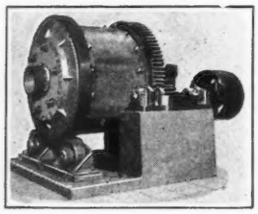
109 DUANE STREET, NEW YORK

Recovery Increased



from 65% *to more than* 90%

—with Lowered Operating Costs!

Illustrated Above

A 25-35 ton screenless type Rib-Cone Ball Mill, easily converted into a screen type.

•

Send for Bulletin 115

Get details and low prices on crushers concentrators, flotation and cyanide machines, amalgamation plates, etc.

With gold at the present price you can't afford to let it go to the tailings dump! Straub equipment will save it, as it is for many mines who have increased their recovery tremendously. From 65% to more than 90% is not unusual. And Straub equipment does it with less power, less water, and with a saving in first costs!

OUR SERVICE TO STRAUB MINES IS COMPLETE MFG. CO.

567 Chestnut St., Oakland, Calif.

MERRILLITE

ZINC DUST

Because of its increased efficiency, Merrillite is preferred. A highly refined zinc dust, of extreme fineness and always uniform.

Its source is a guarantee of quality

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THE ALLOYS COMPANY
Subsidiary of The Merrill Co.
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MERRILL-CROWE PRECIPITATION PROCESS

• *Simultaneous Clarification-Precipitation Type*

The greatest precipitation improvement since the introduction of the Crowe De-aeration Process. Ask for details.

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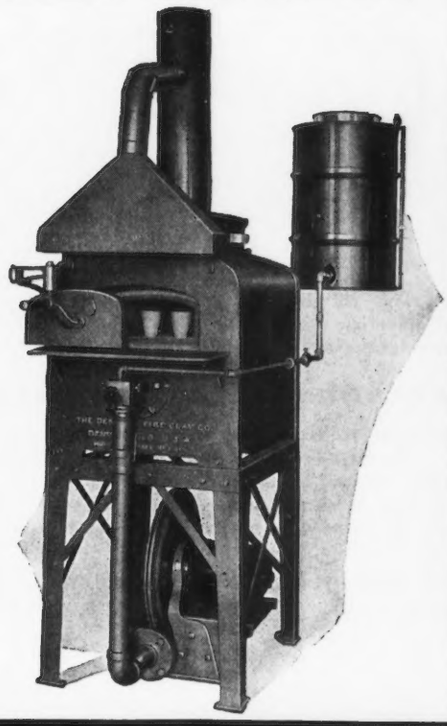

Obsolete Equipment COSTS TOO MUCH!

ANY variation in your basis of settlement is 50% more serious today than it was before gold increased in price. Mining activity is reaching new levels; assays must be RAPID as well as thoroughly accurate.

You cannot afford old, badly worn and inefficient equipment now. And you can't afford any NEW equipment that does not give you the full advantages enjoyed by users of

DFC ASSAY FURNACES

Positive control of temperatures and atmospheric conditions... generous insulation... low fuel consumption... great freedom from repairs.

Write today for full information!

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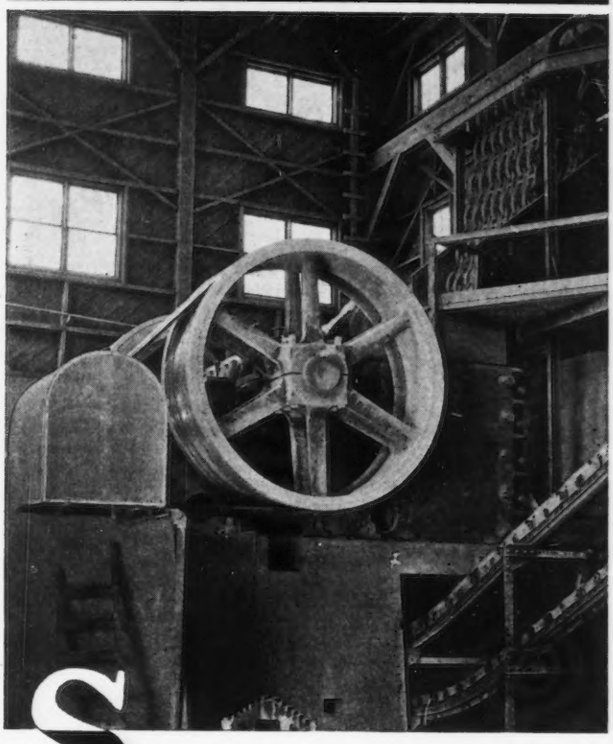


Serving America's most tough ' ' '

Two Birdsboro-C. G. Buchanan Company Jaw Crushers, one 48" x 60" (photo)—a primary at the mine and one 10" x 16"—a secondary at the conversion plant reducing Ferro-Alloy—the ultimate of crushing hardness.

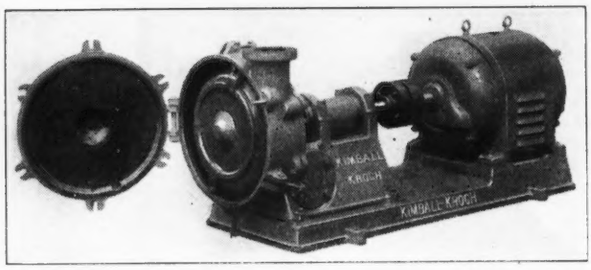
Extraction from unsolicited letter extolling the merits of the secondary installation:

"Our Ferro-Alloy has a low Carbon and a low Silicon content which makes it very hard to crush. Before purchasing your machine sample lots were sent to a number of different type of crushers, including a Birdsboro-C. G. Buchanan, and selected yours from the results so secured. Many of the crushers were unable to handle our material at all."

BUCHANAN
C. G. BUCHANAN COMPANY
INCORPORATED
90 WEST STREET
NEW YORK, N. Y.
Subsidiary of—Birdsboro Steel Foundry & Machine Company
Birdsboro, Pennsylvania, U. S. A.

Represented in Canada by—Fraser & Chalmers of Canada, Ltd.,
1411 Crescent St., Montreal, Que. G. E. Sancton, Gen. Mgr.

CAN YOU GET THESE
ECONOMIES
In Any Other
Sand and Tailings Pump?



• There are other good sand and tailings pumps—but in the new Victor Kimball-Krogh, comparison proves, you get

Longer Continuous Operation

five of the six parts subject to excessive wear are of special, abrasive-resistant iron alloy—the sixth, the suction nozzle is stainless steel . . . two oversize ball bearings on cast-iron box base maintain properly balanced shaft . . . inlet ports through base, reduce vibration.

Higher Maintained Capacity

both impeller and suction nozzle are fitted with wearing rings permitting wear take-up adjustments to maintain original capacity. Adjustment is simple, wearing rings are easily replaced.

Lower Maintenance Costs

instant access to removable wearing parts through hinged end plate—reduces repair time—eliminates disturbing suction or discharge connections . . . packing gland on suction side makes repacking rare—no water seal needed to protect packing or bearings.

If you wish better results per invested and operating dollar, write for Bulletin No. 311.

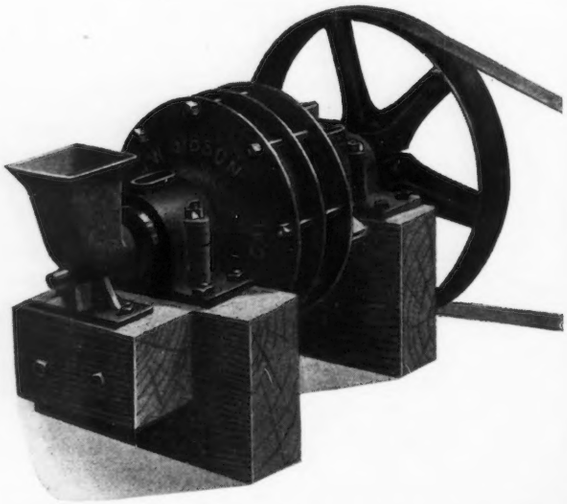
VICTOR KIMBALL PUMPS KROGH

★ OVER 60 YEARS ★ OF PUMP BUILDING ★

VICTOR EQUIPMENT COMPANY

KIMBALL-KROGH PUMP DIVISION

1010 E. 62nd St., Los Angeles—CALIFORNIA, U. S. A.—515 Harrison St., San Francisco



NEVER before has such value been offered to the mining public. The Pocket Hunter will crush 2-inch material, grind and amalgamate in one pass. Built entirely of heat-treated chrome steel and is guaranteed unbreakable. The weight of the elliptic roll, after being filled with lead, is 150 pounds. All other parts weigh under 85 pounds. Capacity 2 tons grinding to 30 mesh.

Price with 1½ H.P. engine and belting $250.00. Price without power $185.00.

Write for catalogue describing Gibson Counter Balanced Rod and Ball Mills, Prospectors' Friend Mills, Flotation Cells, Amalgamators, Concentrators, Rock Breakers, Ore Feeders, Mercury Feeders, Oil Feeders and Retorts.

W. W. GIBSON

112 Market Street San Francisco, California

LOOK Before You Leap

Don't commit your company to large expenditures in development work until you have a true picture of your subsurface conditions.

GEOPHYSICAL SURVEYS

Made by a pioneer organization using patented equipment—an experienced personnel under the technical direction of Dr. J. J. Jakosky, with over 200 successful surveys extending from northern Canada to Mexico.

Lode, Placer, Oil & Dam Site Problems

Rapid and proven methods for determining main zones of mineralization, thickness of overburden and gravels, bedrock contours and rock conditions; at less than one-tenth the cost of direct exploration methods.

Complete Electric, Seismic and Magnetic Equipment

Correspondence regarding development problems cordially invited.

INTERNATIONAL GEOPHYSICS

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Flotation Oils, including

G.N.S. No. 5 Pine Oil

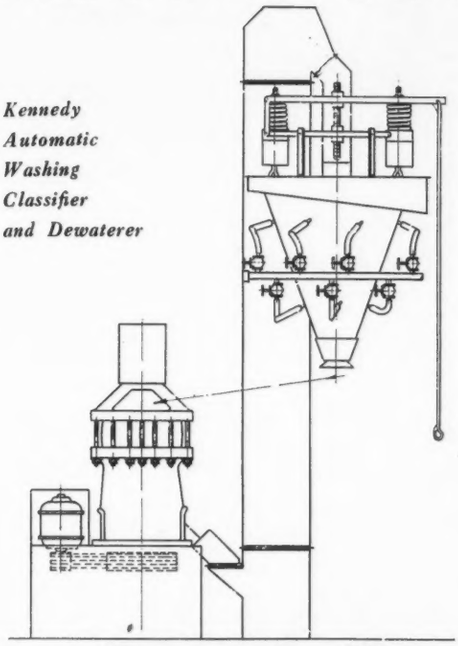
Long the Standard Frothing Oil

Stocks in principal distributing centers

General Naval Stores Co.

230 Park Ave., New York, N. Y., U.S.A. Cable Genstors

REDUCE YOUR MILLING COSTS



Kennedy Automatic Washing Classifier and Dewaterer

For a 50 Ton Mill Use . . .
One Kennedy No. 14½ Ball Bearing Gearless Crusher to reduce 3 in. ore to 90 mesh ready for flotation, concentration, or cyanidation.

It has a 3 in. receiving opening and will handle approximately 10 tons per hour with a 20 H.P. motor when operated in closed circuit with a classifier. The crusher can be driven by a flat or K-V belt.

Thus the No. 14½ crusher eliminates the need for ball mills and other reduction machinery. The saving in building costs, due to smaller area, and other incidentals is usually sufficient to pay for the crusher. Low cost grinding for any mill will be assured by the use of these crushers.

Kennedy Ball Bearing Gearless Crushers with the troubles left out will crush more rock of any size than any crusher in the world with a saving of 50% in H.P. and 80% in the cost of maintenance. They are built in sizes weighing from 1,000 to 900,000 pounds.

Write for particulars and catalogue showing our complete line of mining equipment manufactured in the United States, Canada, Australia, France, and England.

Kennedy-Van Saun Mfg. & Eng. Corp.

No. 2 PARK AVENUE NEW YORK CITY

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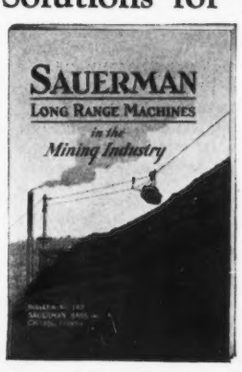
MANUFACTURING PLANTS: Wm. Kennedy & Sons, Owen Sound, Ont., Canada. Sheepbridge Coal & Iron Co., Bush House, London, Eng. Cie des Entreprises Industrielles, Paris, France, 40 Rue des Mathurins. Walkers Ltd., Maryborough, Queensland, Australia.
AGENTS: W. S. Thomas, Johannesburg, So. Africa, 73 Cullinan Bldg. Booth, Macdonald & Co., Ltd., Christchurch, New Zealand.

Solutions for Many Problems of



Digging and Handling Gravel, Ore, Tailings— are in this Booklet.

Concise data on the uses of Sauerman long range machines in working placer deposits, stripping, reclaiming tailings, etc. is given in the new Sauerman Bulletin No. 142. Write for this booklet today and get the latest ideas on how to reduce your digging and handling costs with Slacklines and Drag Scrapers.

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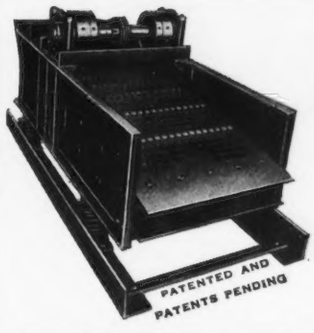

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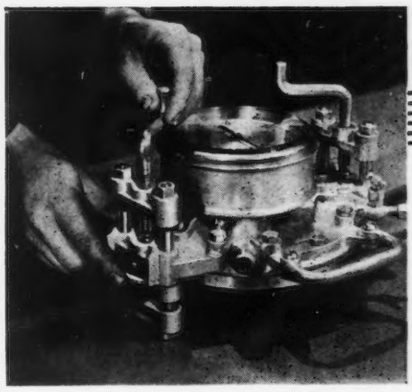

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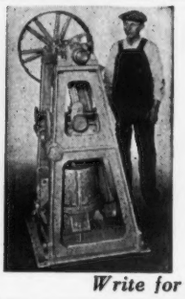

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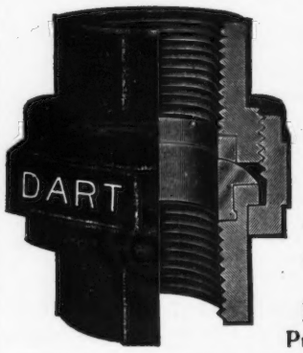

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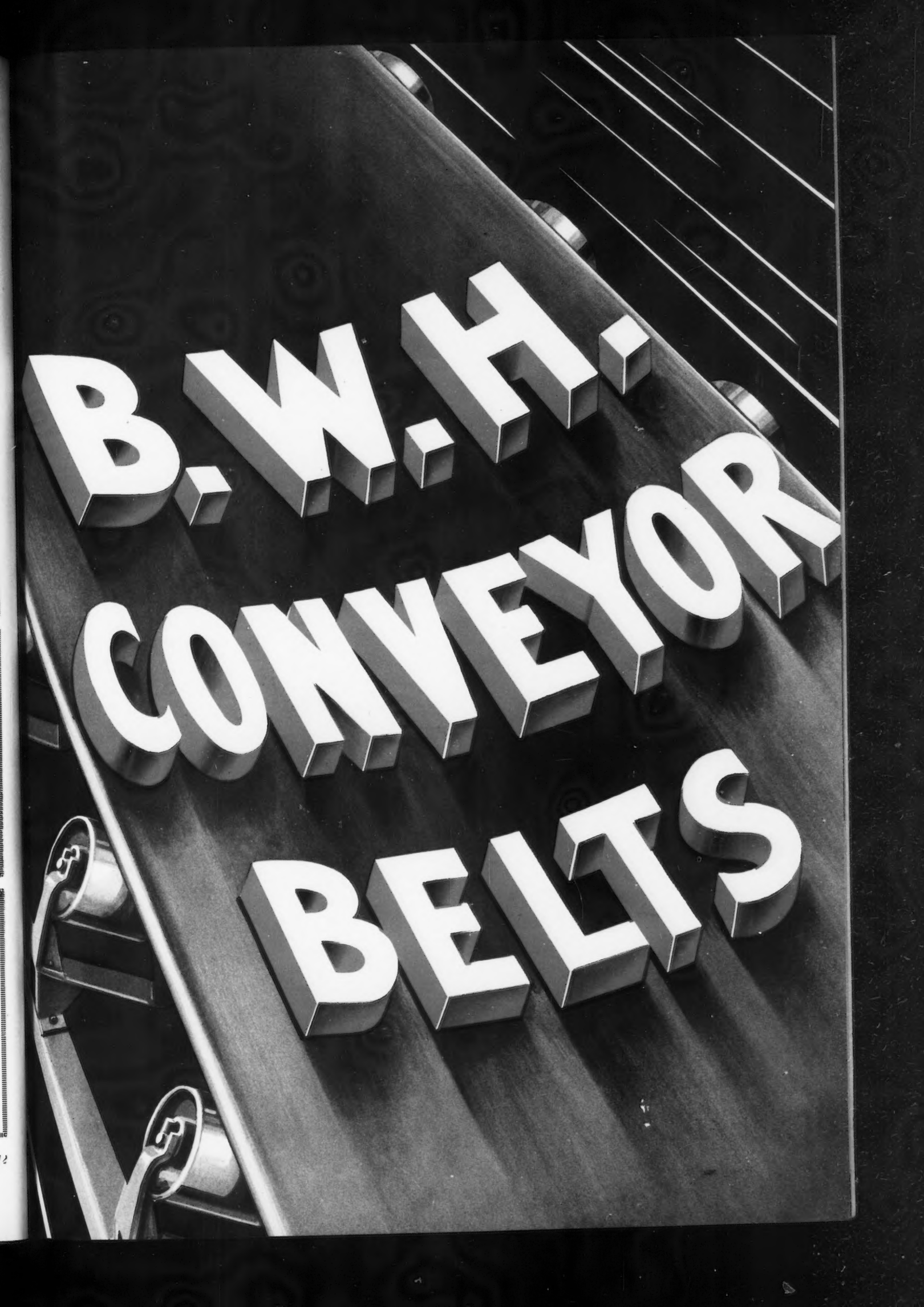
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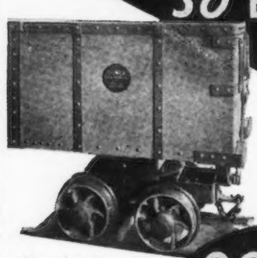

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1—6-ft.x6-ft. Allis-Chalmers, 100-hp. Motor
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5—26x24-ft. Agitators
8—24x20-ft. Agitators
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3—18x18-ft. Agitators
3—14x10-ft. Agitators
6—12x12-ft. Agitators
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12—4-ft. Diam. Filters, all lengths from 2-ft. to 6-ft., 25 to 75-sq.ft.

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1—300-hp. Lidgerwood, Post Brake
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1— 75-hp. Denver Engineering Works
2— 50-hp. Vulcan Iron Works
1— 40-hp. Vulcan Iron Works
1— 30-hp. Hendrie & Bolthoff
2— 25-hp. Vulcan Iron Works
4— 20-hp. Vulcan Iron Works

Double Drum

1—200-hp. Wellman-Seaver-Morgan
1—100-hp. Wellman-Seaver-Morgan
1—100-hp. Denver Eng. Works
1— 50-hp. Vulcan Iron Works
1— 30-hp. Vulcan Iron Works
1— 15-hp. Hendrie & Bolthoff

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2—Type 37, Hum-mer, Single Surface
2—Type 37, Hum-mer, Double Surface
3—Type 42, Hum-mer, Single Surface
1—Type 42, Hum-mer, Double Surface
4—Type 5, 40x60-in. Mitchell

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1—2000-cu.ft. Ingersoll-Rand, PRE-2
1—1300-cu.ft. Ingersoll-Rand, XRB-2
1—1175-cu.ft. Ingersoll-Rand, XRB
1— 800-cu.ft. Worthington
1— 600-cu.ft. Chicago Pneumatic, 0-CB
1— 500-cu.ft. Ingersoll-Rand, XRB-2
1— 300-cu.ft. Ingersoll-Rand, XRB-2
1—1445-cu.ft. Ingersoll-Rand, Class J.

Single Stage Belt Driven

1—575-cu.ft. Ingersoll-Rand, ER-1
2—375-cu.ft. Ingersoll-Rand, ER-1
1—120-cu.ft. Ingersoll-Rand, ER-1
1—115-cu.ft. Sullivan, WG-3
1— 92-cu.ft. Sullivan, WG-6
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1—1300-cu.ft. Sullivan WN-32 direct connected to 260-hp. Fairbanks-Morse Model 32 Diesel Engine, with all accessory equipment.

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1—6-in. McCool Disc Pulverizer
1—Allis-Chalmers Ring & Cone Pulverizer
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3—No. 1 M. & S. Ring & Cone Pulverizer

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1—4-in.x10-in. Blake Sampling Crusher
6—4-in.x6-in. Universal Type Crushers
4—2¼-in.x3½-in. Universal Type Crushers

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1—2 Muffle Oil Furnace, Muffle size 12x20-in.
2—1 Muffle Oil Furnaces, Muffle size 12x20-in.
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2—1 Muffle Oil Furnaces, Muffle size 17x23-in.
4—Gasoline Furnaces, Muffle size 10x16-in.

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2—Tyler Motor Driven "Ro-Tap" Sieve Shakers.

BUTTON BALANCES

3—Type 0B Keller, 1/500-mg.
1—Type 8, Henry Troemmer 1/400-mg.
2—No. 4, Christian Becker, 1/200-mg.
3—Type "E", Ainsworth, 1/200-mg.
1—Type RA, Ainsworth, 1/100-mg.

ANALYTICAL BALANCES

1—Type "Q", Ainsworth, 1/20-mg.
2—No. 3, Troemmer, 1/50-mg.
1—Christian Becker, 1/20-mg.
1—Christian Becker, 1/10-mg.

PULP BALANCES

2—Christian Becker, 1/10-mg.
1—Ainsworth, 1/10-mg.
1—Fig. 25, Henry Troemmer, 1-mg.
2—No. 33, Thompson, 1/20-mg.

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2—54-in.x18-ft.x12-ft. Diam. Bowl, Model "DSD"
1—27-in.x18-ft.x8-ft. Diam. Bowl, Ex. Hy.
1—15-in.x16-ft.x4-ft. Diam. Bowl, Model "C"

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1—Oliver Continuous Drum Type Filter, size 5'x4'.
1—Oliver latest type with oscillating agitator, size 6'x12'.
1—Oliver Continuous Drum Type with oscillating agitator, 8'x8'.
2—American Disc Filters, 4'x1 disc.
1—American Disc Filter, 4'x2 disc.
1—American Disc Filter, 4'x4 disc.
1—American Disc Filter, 6'x2 disc.
1—American Disc Filter, 6'x3 disc.
1—American Disc Filter, 6'4 disc.
2—American Disc Filters, 12'x4 disc.
All complete with necessary vacuum equipment.

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1—2" Wilfley Sand Pump, belt driven.
3—4" Wilfley Sand Pumps, belt driven.
2—6" Wilfley Sand Pumps, belt driven.
3—4" Krogh belt driven Sand pumps.
2—3" Byron-Jackson belt driven Sand Pumps.
1—6" Byron-Jackson motor driven Sand Pump.
1—6" Krogh direct motor driven Sand Pump.

CYANIDE EQUIPMENT

2—Merrill-Crowe Triangular 36"x20 plate, plate and frame Precipitation Presses.
2—Merrill Clarifying Units, complete.
2—Spiral-type Zinc Feeders and Cones.

BALL MILLS

1—4'x4' Colorado Iron Works Grate Discharge, complete with liners.
2—4½'x16" Hardinge Conical, comp. with liners.
1—5'x5' Colorado Iron Works, com. with liners.
2—6'x22" Hardinge Conical Ball Mills for direct motor drives thru Herringbone gears.
1—8'x36" Hardinge Conical, com. with liners.
1—8'x22" Conical Pebble Mill with silex liners.
1—No. 64½ Marcy Ball Mill complete with speed reducer drive, size 6'x12'.
1—4'x4' New EIMCO Ball Mill, comp. with liners.
1—6'x6' New EIMCO Ball Mill, comp. with liners.
1—6'x20' Allis-Chalmers Grate Discharge Tube Mill, complete with liners.
1—6'x12' Marcy Open End Rod Mill with motor drive.

CLASSIFIERS

3—Dorr Model "C" Simplex Classifiers, size 2'3"x14'8".
3—Dorr Model "C" Duplex Classifiers, size 4'6"x14'8".
2—Model "C" Heavy Duty Duplex Classifiers, size 6'20" with "V" belt drives to motor.
1—Dorr Bowl Classifier, type D5DB, size 8'x31'8" and 18' bowl.
2—45" Akins Classifiers.
2—54" Akins Classifiers.

THICKENERS AND AGITATORS

2—75'x15' Dorr Thickeners, complete with steel superstructures.
1—60'x12' Dorr Thickeners, complete with steel superstructures.
2—40'x10' Dorr Thickeners, complete with steel superstructures.
2—34'x12' Dorr Thickeners, complete with steel superstructures.
2—24'x8' Dorr Thickeners, complete with steel superstructures.
3—14'x6' Dorr Thickeners, complete with steel superstructures.
2—12'x8' Dorr Thickeners, complete with steel superstructures.
3—20'x8' Dorr Thickeners, complete with steel superstructures.
2—Dorr Agitators, complete, size 30'x20'.
3—Dorr Agitators, complete, size 20'x16'.
3—Dorr Agitators, complete, size 16'x14'.
6—Propeller-type Agitators, size for 12', 14', 20', 30' tanks.

ORE FEEDERS AND CONVEYORS

2—Meese & Gottfield Belt Feeders, 36" wide by 19' 1½" long, mounted on structural steel base with var. speed drives and speed reducers.
1—Link-Belt Malleable Iron Apron Conveyor, 60' centers, 24"x12" pans, complete with supporting steel underframe and drive (suitable for handling hot ashes, roaster products, etc.)
1—Robbins Pan Feeder, with motor drive, size 24" wide by 9' centers.
2—EIMCO adjustable-speed Belt Ore Feeders, belt drive, size 16"x5'.
1—Stephens-Adamson Belt Conveyor, 36" by 400' complete, but without belt.

CRUSHERS

1—Farrel Blake Type Jaw Crusher, belt driven, size 10"x20".
2—Allis-Chalmers Blake Type Jaw Crushers, size 10"x20".
1—Worthington Blake Type Jaw Crusher, 16"x24".
2—Allis-Chalmers Gyratory Crushers, style "K," size No. 5.
1—Allis-Chalmers Gyratory, style "K," size No. 8.
1—Telsmith Reduction Crusher, size No. 32.
1—Set Allis-Chalmers Crushing Rolls, style "B," size 30"x14".
2—Sets Allis-Chalmers Crushing Rolls, style "XX," size 48"x16".
2—Sets Colorado Iron Works Crushing Rolls, size 42"x16".
1—Allis-Chalmers Blake Type Jaw Crusher, size 30"x18".
1—Allis-Chalmers Blake Type Jaw Crusher, size 36"x24".
2—Aurora Blake Type Crushers, size 11"x20".
1—Set 36"x16" Traylor Crushing Rolls.

Eastern Iron & Metal Co.,

634 South 4th West St., Salt Lake City, Utah, U.S.A.

Cable Address "EIMCO"

BARGAINS

SPECIAL

ELECTRIC HOIST

1—New 150 hp. Hendy double drum electric hoist with jaw clutches, post brakes and direct connected to
1—150 hp., 3 phase, 60 cycle, 2200 volt, type "C I" Westinghouse motor with full magnetic hoist control, suitable for regenerative lowering or dynamic stopping.
Price f.o.b. San Francisco, Calif. $5,000

ELEVATORS

1—8x5 chain buckets, 35 ft. centers.
1—6x12 chain buckets, 30 ft. centers.
1—5x8 chain buckets, 40 ft. centers.
1—10x5 belt buckets, 40 ft. centers.
1—5x8 belt buckets, 32 ft. centers.
1—15x9x8 belt buckets, 60 ft. centers.

Send for complete Stock List

J. E. KNAPP Co.
593 MARKET ST SAN FRANCISCO
GUARANTEED EQUIPMENT

The Searchlight Section of this paper

is devoted exclusively to the advertising of idle used and surplus new machinery, and all other employment and business "Opportunities" identified with the field covered by this paper.

"Searchlight" ads are referred to regularly by readers interested in such "Opportunities."

You can reach them quickly and at small cost through an advertisement in the Searchlight Section.

0310

SEARCHLIGHT SECTION

EMPLOYMENT : BUSINESS : OPPORTUNITIES : EQUIPMENT—USED or SPECIAL

UNDISPLAYED—RATE PER WORD:

Positions Wanted (full or part-time salaried employment only), 5 cents a word, minimum $1.00 an insertion, payable in advance.

Positions Vacant and all other classifications 10 cents a word, minimum charge $2.00.

Proposals, 40 cents a line an insertion.

INFORMATION:

Box Numbers in care of our New York, Chicago or San Francisco offices count 10 words additional in undisplayed ads.

Discount of 10% if one payment is made in advance for four consecutive insertions of undisplayed ads (not including proposals).

Continued from pages 21 and 22

DISPLAYED——RATE PER INCH:

1 inch $6.00
2 to 3 inches..... 5.75 an inch
4 to 7 inches..... 5.50 an inch

Rates for large spaces, or yearly rates, on request.

An advertising inch is measured vertically on one column, 3 columns—30 inches—to a page. E.M.J.

Copy for new advertisements received until December 28th for the January issue.

FOR SALE

10—**Hardinge Ball Mills**, 3'x8", 4½x16, 5x22, 6x22, 6x36, 7x36, 8x22, 8x30, 8x48, 8x72.
8—**Rod Mills**, 4x8, 4x10 **Marathon**; 5x10 **Allis Chalmers**; 5x10 **Traylor**, 5x10 **Marcy**.
20—**Dorr Classifiers** and **Thickeners** of various sizes.
4—**American Filters**, 4' one disc, 6' two disc, 4' eight leaf.
3—No. 450 **Kelly Filters**, 10 leaves, 1 monel leaves.
1—24"x72" **Magnetic Pulley**, complete.
8—**Oliver Filters**, 3x1, 3x2, 6x4, 6x6, 6x1 top feed type, 5x12, 8x8, 8x12, 12x12.

Send for latest Consolidated News listing all sizes, types **Jaw, Gyratory** and **Roll Crushers, Fine Reduction Crushers, Thickeners, Classifiers, Ball, Rod** and **Tube Mills, Rotary Kilns** and **Dryers, Vibrating Screens, Pumps, Conveyors, Filter Presses, Continuous Filters**, also **Mills for fine pulverizing, Air Classifiers, etc.**

CONSOLIDATED PRODUCTS CO., INC.

13-19 PARK ROW
NEW YORK CITY

Shops and Yards at
Newark, N.J., cover six acres.

CABLE ADDRESS
"EQUIPMENT"

We will buy your surplus machinery.

FOR SALE

GOLD DREDGE

Used six cubic foot, close connected bucket, electric powered gold dredge capable of digging 55 feet below water line, in good condition and within a short distance of railroad.

FS-421, Eng. & Min. Journal
520 No. Michigan Ave.,
Chicago, Ill.

FOR SALE

One new 8'x125' rotary kiln.
One 6'x8' Traylor ball mill.
One new 8'x22" Hardinge ball mill.
One new 5'x40' rotary dryer.
One new 28' Dorr thickener.
Also a lot of good used crushing rolls from 16"x10" to 54"x24".
Jaw crushers from 4"x8" to 56"x72".
Swing hammer mills and ring roll mills.
Gyratory and rotary fine crushers.
Ball and tube mill from 3' to 7' in diam.
Hardinge, Raymond, Fuller & Marcy mills.
Rotary dryers & Kilns from 3' to 8' in dia.
Wedge, Bruckner & Monarch furnaces.
Dorr thickeners & Classifiers.
Jigs & Tables.
Vibrating screens & Air Separators.
Mine hoists—Air compressors—Pressure blowers—Filters—Evaporators.
One Allis-Chalmers 20" blast furnace.
One Dwight-Lloyd Sintering Machine.
Shovels & Cranes—Oil Engines.

W. P. HEINEKEN, *Engineer*
95 Liberty St., New York
Tel. BAr. 7-7298

"SEARCHLIGHT"

IS

Opportunity Advertising

—to help you get what you want.

—to help you sell what you no longer need.

Take Advantage Of It

For Every Business Want

"Think SEARCHLIGHT First"

G-7

FOR SALE

800-Ton Plant for precious metal mining, with primary and fine reduction Crushers, Conveyors, three 5x10-ft. Rod Mills in closed circuit with Dorr Classifiers, Rotary Vacuum Filters, Dryers, Screens, Pumps, Electrostatic Separators, etc. Built 1929. Will sell outright or take interest with responsible parties in good gold development.

FS-527, Engineering & Mining Journal

330 W. 42nd St., New York City

FOR SALE

CRUSHER

Allis-Chalmers 10", Style "B" Newhouse Crusher Complete. Improved Concaves. First Class Condition.

Purchasing Department

BOUND BROOK CRUSHED STONE CO.
P. O. Box 429, Morristown, N. J.

POSITION VACANT

WANTED—Mill Supt. South America three year contract operate mill employing gravity concentration, also conduct experiments selective flotation lead, zinc, et cetera. High elevation. Reply with full particulars to P-534, Engineering & Mining Journal, 883 Mission Street, San Francisco, Calif.

EMPLOYMENT SERVICE

SALARIED POSITIONS, $2,500 to $25,000. This thoroughly organized advertising service of 25 years' recognized standing and reputation carries on preliminary negotiations for positions of the caliber indicated through a procedure individualized to each client's personal requirements. Several weeks are required to negotiate and each individual must finance the moderate cost of his own campaign. Retaining fee protected by a refund provision as stipulated in our agreement. Identity is covered and, if employed, present position protected. If you have actually earned over $2,500, send only name and address for details. R. W. Bixby, Inc., 264 Delward Bldg., Buffalo, N. Y. (E. M. J.)

EMPLOYMENT AGENCY

AMERICAN ENGINEERS SERVICE, Transportation Building, Washington. Employment service for managers, superintendents maintenance engineers, draftsmen, surveymen; mining, melters, refineries, bridges, highway, machinery. North-South American developments.

POSITIONS WANTED

CHEMIST—Assayer, experienced smelterman, 18 years Latin-America and Southwest, desires connection metallurgical department nonferrous smelter, reduction plant or mine, or assist on prospect examinations. Fluent Spanish. Excellent references. PW-532, Engineering and Mining Journal, 520 No. Michigan Ave., Chicago, Ill.

CHEMIST-ASSAYER, with fifteen years' experience best companies, desires position with reliable mining company. References on request, experienced mill lines. C. H. Tuller, 2855 Vine Street, Denver, Colorado.

EXPERIENCED mining engineer, technical graduate, age 32, 8 years' underground and open pit mining and mine development. Excellent references. PW-526, Engineering and Mining Journal, 330 West 42d Street, New York City.

MANAGER of a producing gold mine by experienced mining engineer. PW-514, Engineering and Mining Journal, 330 West 42d St., New York City.

MANAGER or superintendent open for engagement February 1st. Technical graduate; now holding Government position. Able to develop new properties; married, go anywhere. Write for experiences. PW-529, Engineering and Mining Journal, 520 No. Michigan Ave., Chicago, Ill.

MANAGER or GEN. SUPT., of Gold Mine of merit, by engineer with wide and intensive experience in gold mining operations. Thoroughly experienced in every detail of metallurgical and mining practices involved. Age 43. Married. PW-533, Engineering & Mining Journal, 883 Mission Street, San Francisco, Calif.

MILLMAN—Extensive and thoroughly experienced. Amalgamation, cyanide, flotation, ore testing and assaying. PW-530, Engineering and Mining Journal, 883 Mission St., San Francisco, Calif.

MINING ENGINEER, one year's experience on surveys, seeks connection offering future. Salary secondary. Location immaterial. PW-523, Engineering and Mining Journal, 330 West 42d St., New York City.

MINING ENGINEER desires position as mine foreman or shift boss. Age 29, married, speaks Spanish; 8 years' experience in United States and foreign countries in operating end. References. PW-469, Engineering and Mining Journal, 520 No. Michigan Ave., Chicago, Ill.

MINING ENGINEER, 37 years old, married, no children, wants any kind of a mining job. Experienced in engineering and operating gold, silver, coal and phosphate mining. Speaks Spanish and will go anywhere with a few days' notice. PW-531, Engineering and Mining Journal, 520 No. Michigan Ave., Chicago, Ill.

(Continued on following page)

1 to 50 Tons Capacity

Automatics!

(Dump 20 a minute without labor!)

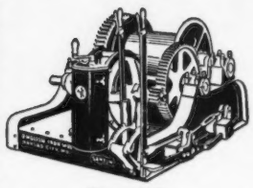
The Quality of Our Wheels is Superb

(Try us on Repair Wheels or Trucks)

Other types of Ore Cars

Sanford-Day Iron Works, Knoxville, Tenn.

. . . HOISTS . . .



Type MS
Friction Drum Electric Hoist

Frames of Hoist are fabricated Steel, strongly riveted and rigidly braced, practically indestructible; lighter than cast iron.
Sizes, loads 4,000 to 6,000 pounds.
Drum diameters up to 30".
In these Hoists is incorporated, the best in engineering practice.
Bulletins upon request.

English Bros. Machinery Co.
Manufacturers
KANSAS CITY, MO.

PRINTERS *for the* MINING INDUSTRIES

Indicates that we can render a higher standard of service combined with the better grade of quality on any kind of printed matter.

DALY TICKET CO., Collinsville, Ill.

SEARCHLIGHT SECTION

(Continued from pages 21, 22 and 23)

We Own and Offer For Sale

The largest known tonnage of high-grade chromite in this country. Location northern California. Tests by U. S. Bureau of Mines show it can be concentrated to 63% CR_2O_3. Very low in iron. Considerable development work. Will sell on reasonable terms.

H. W. GOULD & Co.
Mills Bldg., San Francisco, Calif.

First Class

Gold and Silver Mine

FOR SALE, LEASE or WORK in partnership with party willing to invest $10,000 to $20,000 capital. Write:

Cia Minera "El Orito" Plaza Pral Acerca Norte 3. Aguascalientes, Ags. Mexico.

BUSINESS OPPORTUNITIES

For the information of readers: Organizing and incorporating costs incurred in connection with capital raising services are usually quoted as a separate cost not conditioned upon or related to the actual raising of capital or any fees earned thereby.

Raising Capital
Inquiries solicited from corporations interested in raising capital through marketing corporate securities. The Brookworth Co., Inc., 110 East 42d St., New York, N. Y.

Mining and Oil Companies
Organized and financed. James Murrow, 299 Broadway, New York.

Want Associate For Manufacturing
And marketing products from non-metallic mineral deposit. Alf Enkeboll, Box 124, Humboldt, Arizona.

CAPITAL WANTED

To Prospect in Africa
Experienced mining prospector and promoter desires to secure capital. Address Frank Warning, Oatman, Arizona.

"Ground Floor Proposition"
for capital to diamond drill on direct trend of the Great Tonopah Vein System, that has produced $2,000,000,000 gold, silver ores. Chas. E. Perry, 412 University Ave., Reno, Nev.

WANTED

ANYTHING within reason that is wanted in the field served by Engineering & Mining Journal can be quickly located through bringing it to the attention of thousands of men whose interest is assured because this is the business paper they read.

CAPITAL AVAILABLE

An experienced group ready and able to act promptly is interested in purchasing all or control of developed or partly developed gold mines where enough work has been done to indicate clearly the presence of commercial ore. The properties are desired for actual mining operations; not for stock promotion.

Kindly submit in strict confidence in your first letter assay maps, engineering reports and terms in sufficient detail to permit an intelligent office study to be made preliminary to an interview.

R. POTTER CAMPBELL, INC.
84 William Street, New York City

THE TONOPAH MINING CO. OF NEVADA

EXPLORATION DEPARTMENT
Prospects of Merit Financed
Write Either

H. A. JOHNSON, Supt. of Operations, Tonopah, Nevada
Or Main Office 570 Bullitt Bldg. Philadelphia, Pa.

"Opportunity" Advertising:
Think
"SEARCHLIGHT"
First

KNOW

"I ~~HOPE~~ I PURCHASED THE RIGHT WIRE ROPE"

A SILVER STRAND ELIMINATES DOUBT

IN THE selection of Wire Rope—the difference between "know" and "hope" is frequently the difference between economy and needless cost. There is never a doubt, as far as Wire Rope quality is concerned—or economy either—when a Silver Strand governs choice. Monitor Silver Strand Wire Rope is made exclusively by the American Steel & Wire Company—the largest manufacturers of Wire Rope in the world—and service records prove it superior in wear, strength and endurance. Perfectly constructed of the highest quality steel—and with abrasion resisting factors—it is waiting to serve you—to substitute "know" for "hope" in your next Wire Rope order.

AMERICAN STEEL & WIRE COMPANY

MONITOR

SILVER STRAND WIRE ROPE

1831

1934

AMERICAN STEEL & WIRE COMPANY

208 South La Salle Street, Chicago
94 Grove Street, Worcester

SUBSIDIARY OF UNITED STATES STEEL CORPORATION
AND ALL PRINCIPAL CITIES

Empire State Building, New York
First National Bank Building, Baltimore

Pacific Coast Distributors: Columbia Steel Company, Russ Bldg., San Francisco

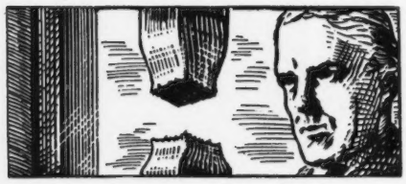
Export Distributors: United States Steel Products Company, New York

A Tower of Torture
for Wire Rope

FOR YOUR PROTECTION: To make certain that Roebling Wire Rope will give the user the highest obtainable degree of safe, economical service, Roebling has left no stone unturned. It has enlisted the aid of the finest and most complete research, testing and manufacturing facilities. This testing machine is an example. John A. Roebling's Sons Company, Trenton, N.J. Branches in Principal Cities.

ONE OF THE WORLD'S LARGEST PRECISION TESTING MACHINES

This giant testing machine has a capacity of 2½ million pounds, is 43 feet high, and weighs 138 tons. Routine specification tests of Roebling Rope are made on this and other Roebling testing machines which range in size down to 200 pounds capacity.

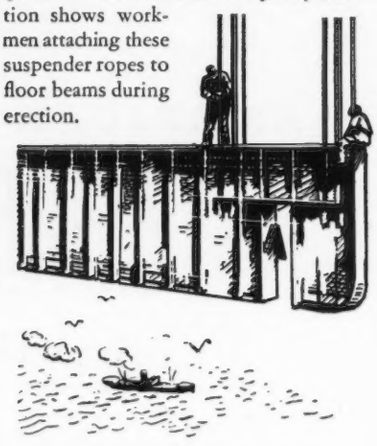


CAN PULL APART 6" SQUARE STEEL BAR

CAN CRUSH CAST IRON COLUMN 15' LONG, 15" DIAM., WITH 1¼" WALLS

CAPABLE OF TESTING LARGEST ROPES MADE

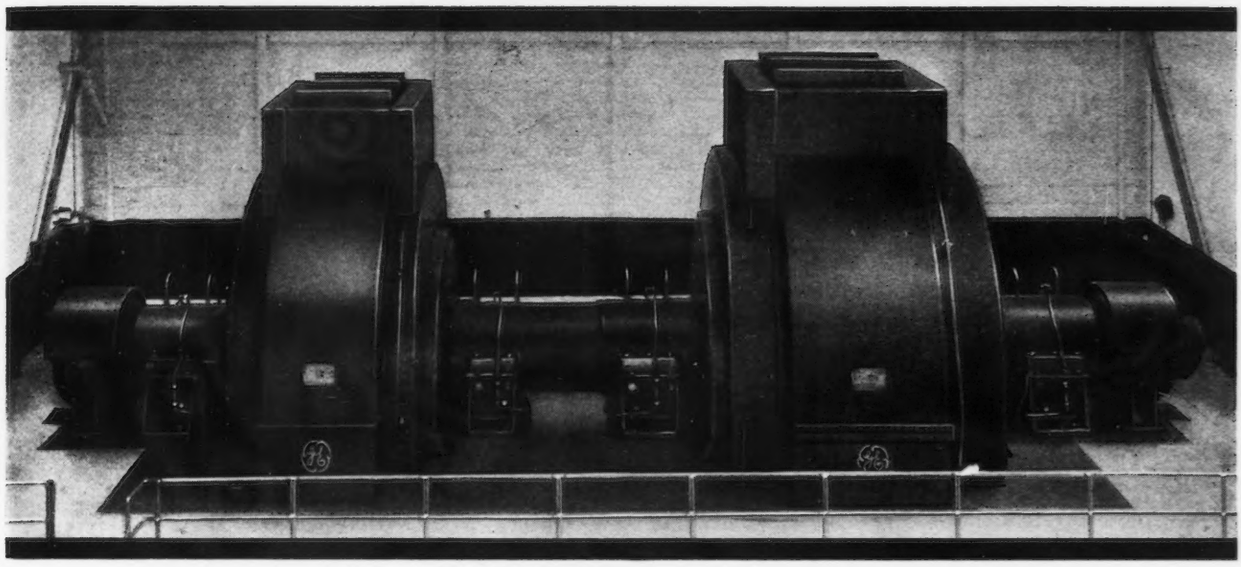
It was first used for tension testing the huge 2⅞ inch Roebling Suspender Ropes for the George Washington Memorial Bridge, between New York and New Jersey. Illustration shows workmen attaching these suspender ropes to floor beams during erection.



ROEBLING ...THE PACEMAKER IN WIRE ROPE DEVELOPMENT

OXYGEN-FREE HIGH CONDUCTIVITY COPPER.....IN THIS 30,000 KVA FREQUENCY CONVERTER

built by General Electric for Public Service Electric and Gas Company



This 30,000 kva frequency converter is installed in the Metuchen Switching Station, Metuchen, N. J., for service to the Pennsylvania Railroad electrification between New York and Wilmington, Del. It is designed to convert 13,200 volt, 60 cyc., 3 phase energy into 11,000 volt, 25 cyc., 1 phase. Station Design & Construction—United Engineers & Constructors Inc., Newark, N. J.

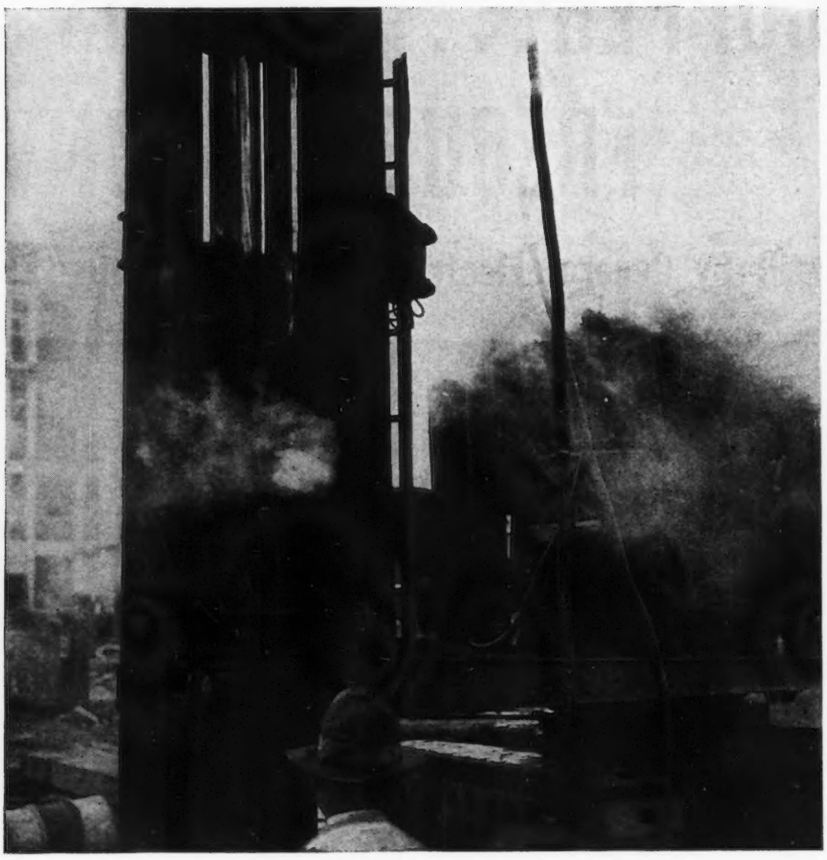
Because of the known superiority of OFHC (oxygen-free high conductivity) copper, it was specified for use wherever copper was required in both units of this set . . . Important designers, manufacturers and users of electrical equipment, realize that OFHC Copper assures unexcelled purity of product, absence of oxide inclusions, and high electrical conductivity . . . Every step of the production of OFHC Copper is controlled to give a product which will live up to the high requirements of important service.

United States Metals Refining Company, 420 Lexington Avenue, New York, N. Y.

OXYGEN-FREE OFHC REG. U.S. PAT. OFF. HIGH CONDUCTIVITY

Linde Process Service

saves $354



FULL STEAM AHEAD—Quick-time repair by bronze-welding fractured steam hammer cylinder saves money—cuts delay on job.

IT looked as if nothing could prevent the expenditure to replace the fractured steam hammer cylinder on the foundation company's pile driver.

A Linde Service Operator was called and, on examining the cylinder, found that it could be made as good as new by bronze-welding. With his cooperation the work was rapidly completed. The cost of materials and labor amounted to about $31—a saving of $354 over the cost of $385 for a new cylinder. Tests proved that the bronze-welded repair was fully capable of withstanding the severe service of everyday operation. The foundation company was highly pleased with the result.

Thus does Linde Process Service work to save time and money for users of Linde Oxygen. It makes available, from the melting pot of thousands of experiences in many industries, sound welding and cutting practices that have a direct bearing on your particular problems. The value of this unique service is further amplified by coordination with the vast resources, scientific research and engineering facilities of other Units of Union Carbide and Carbon Corporation.

Ask your nearest Linde Sales Office how Linde Process Service can be of assistance. These are located in Atlanta, Baltimore, Birmingham, Boston, Buffalo, Butte, Chicago, Cleveland, Dallas, Denver, Detroit, El Paso, Houston, Indianapolis, Kansas City, Los Angeles, Memphis, Milwaukee, Minneapolis, New Orleans, New York, Philadelphia, Phoenix, Pittsburgh, Portland, Ore., St. Louis, Salt Lake City, San Francisco, Seattle, Spokane and Tulsa. Everything for oxy-acetylene welding and cutting—including Linde Oxygen, Prest-O-Lite Acetylene, Union Carbide and Oxweld Apparatus and Supplies—is available from Linde through producing plants and warehouse stocks in all industrial centers.

PRODUCT OF A UNIT OF UCC UNION CARBIDE AND CARBON CORPORATION

The Linde Air Products Company

Unit of Union Carbide and Carbon Corporation

UCC

NRA CODE

In Canada: Dominion Oxygen Co. of Canada, Ltd.

YOU CAN ORDER EVERYTHING FOR OXWELDING AND CUTTING FROM LINDE

The Simple, Practical Principle of TIMKEN BITS eliminates all Reforging Costs

Note that the steel does not bottom in the bit—another reason why the threads are not subjected to wear or damage.

Note how the bit is driven into the rock—against a solid upset shoulder on the steel. No strain on threads.

THE special type of screw threads used to attach Timken Bits to the steel assures easy, quick bit replacement at all times when necessary.

On account of their formation, these threads cannot easily be injured by the hardest drilling. To further protect the threads and bits, an upset shoulder on the steel is provided to take the impact of the hammer blows. The steels do not bottom in the bits under any conditions.

This simple principle makes the removable bit thoroughly practical for all purposes. Combined with correctly-designed bits of Timken fine-grained electric furnace steel it radically reduces drilling costs in all types of rock—above or below ground.

One good trial of Timken Bits will convince you of their economy and other benefits. Write for the Timken Bit booklet.

THE TIMKEN ROLLER BEARING COMPANY, CANTON, OHIO

TIMKEN BITS

New Strength and Stamina in

HOLLOW DRILL STEEL
that practically eliminates breakage

BETHLEHEM Superior Hollow Drill Steel stands the battering of the most powerful drifters with negligible breakage and a minimum of repointing. For Bethlehem Superior is almost immune to fatigue, the greatest enemy of drill steels.

In order to carry out its destructive work fatigue needs a foothold—usually a minute pit or other irregularity in the bore. Bethlehem Superior has a bore free from imperfections. It denies fatigue its essential start.

Further, Bethlehem Superior is given end-to-end heat-treatment, increasing its toughness and inherent fatigue resistance.

This combination of smooth bore and end-to-end heat-treatment in Bethlehem Superior Hollow Drill Steel is one that fits it for the toughest mining jobs.

Abrasion-Defying

STEEL PLATES

FOR chutes and screens and similar parts of mine equipment, which come in contact with abrasive ores, Bethlehem makes a special grade of wear-defying steel plates.

Bethlehem Abrasion-Resisting Plates combine wear-resisting hardness with ductility and machinability. These properties suggest many an application.

★

Mine Track Equipment

Frogs, Switches, Switch Stands, Guard Rails, Crossings. Every item of equipment used in track in and around the mine.

★

88-80 CASTINGS
wear longer in parts subject to abrasion

TO MORE than double the life of ball-mill liners, crusher rolls, and similar parts, calls for decisive superiority in material. And that, according to many users, is just what has been done by 88-80, Bethlehem's new steel for abrasive service.

This new alloy steel contains elements that make it inherently wear-resisting. It does not spall nor develop pockets. It wears very slowly. Tires or rolls made of 88-80 wear evenly across the surface, not concavely. And they offer the same stubborn resistance to wear all the way through. No soft center under a hard surface.

Contributing largely to the long life of 88-80 Castings is the heat-treatment which each casting receives, giving it the characteristics most suitable to the material to be ground.

in Steels for Mining Service

STEEL TIES make better track —cut maintenance cost

DERAILMENTS are almost unknown on track laid with Bethlehem Steel Ties. The rails are held positively true to gage. Maintenance is negligible. Permanent track lasts for years with hardly any attention. No regaging required. No fatigue-broken rails resulting from inadequate support at some point. Bethlehem Steel Ties make the kind of track that keeps haulage costs down.

Ties never become spike-killed, however often they are taken up and relaid. The fastening is as secure after the ties have been in and out a dozen times as when new.

Steel ties are very quickly laid. No spikes to drive. No gaging to be done—the gage is certain to be correct. Two or three blows with a hammer are enough to clamp the rail in the vise-like grip of the locking clips. The labor cost of laying track with steel ties is often less than half of that with wood ties.

Bethlehem Steel Ties have been installed by tens of thousands in coal mines. Their advantages are equally valuable in metal mines. Perhaps more so, on account of the greater weight of the material handled.

Bethlehem No. 2 and No. 3 Ties, together with the Keystone No. 6 Tie for permanent ballasted track, cover practically every application in metal mines. Heavier Bethlehem Ties are available if needed.

BETH-CU-LOY resists Rust— yet it is not expensive

BETH-CU-LOY'S stubborn defiance of rust, and its low cost, are two good points to consider in selecting sheets for roofing and siding on mine buildings.

Sheets of copper-bearing steel—Beth-Cu-Loy's composition—won first place in the famous atmospheric-exposure tests carried out by the American Society for Testing Materials. Copper-bearing steel sheets surpassed all other grades of commercial iron and steel in ability to resist the ravages of rust.

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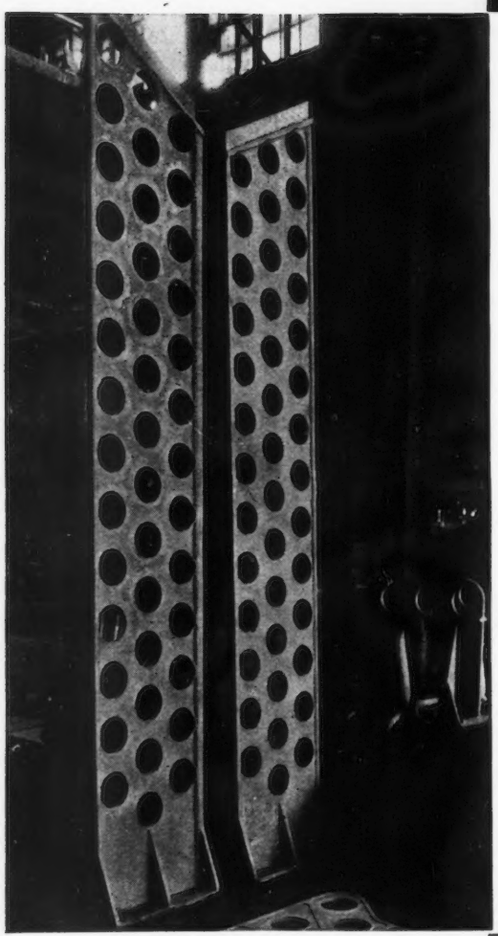

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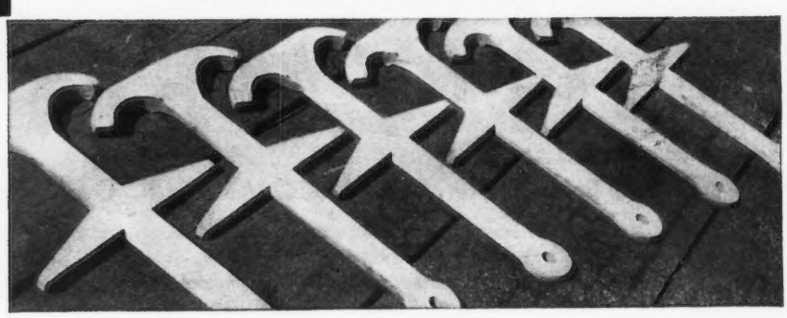

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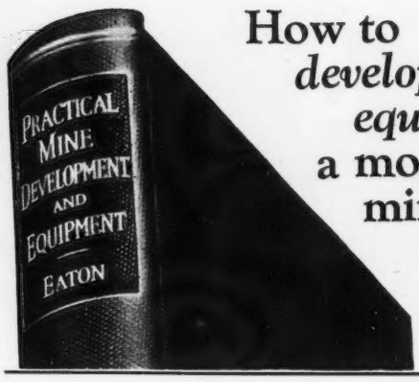

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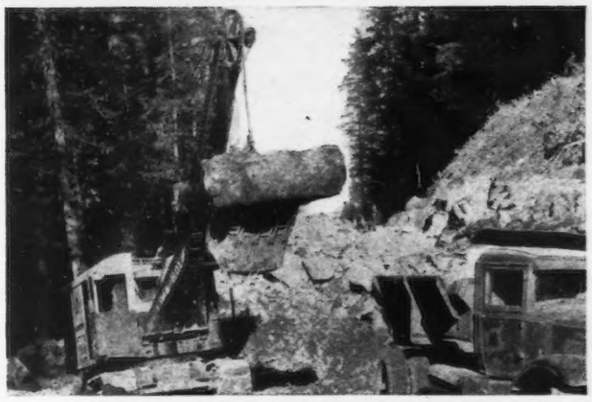

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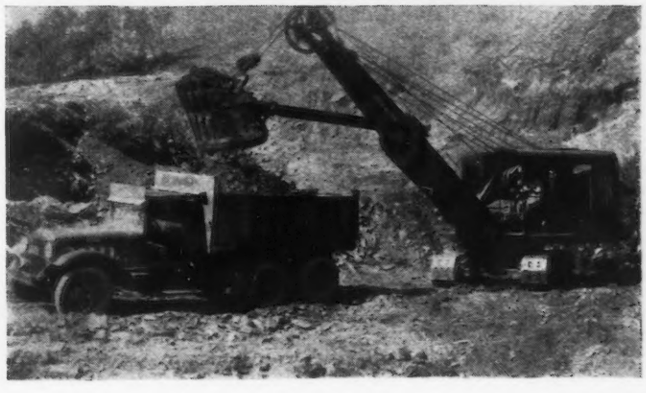

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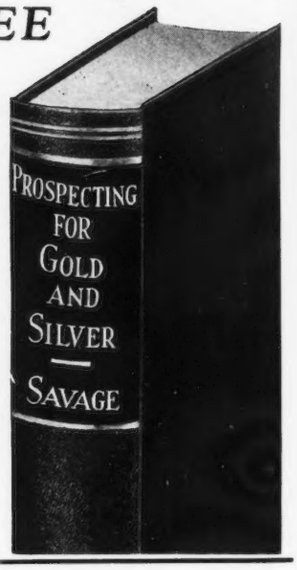

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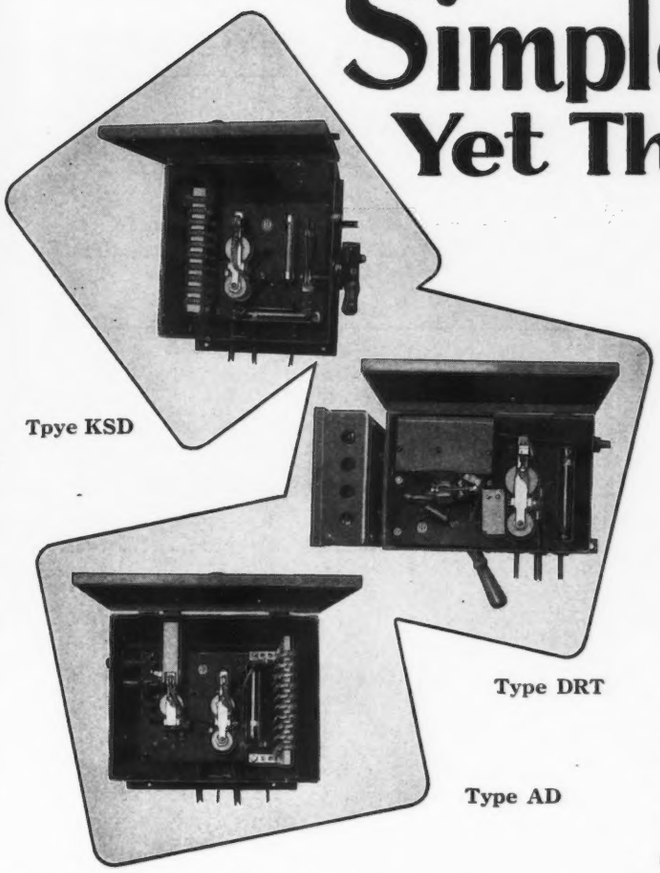

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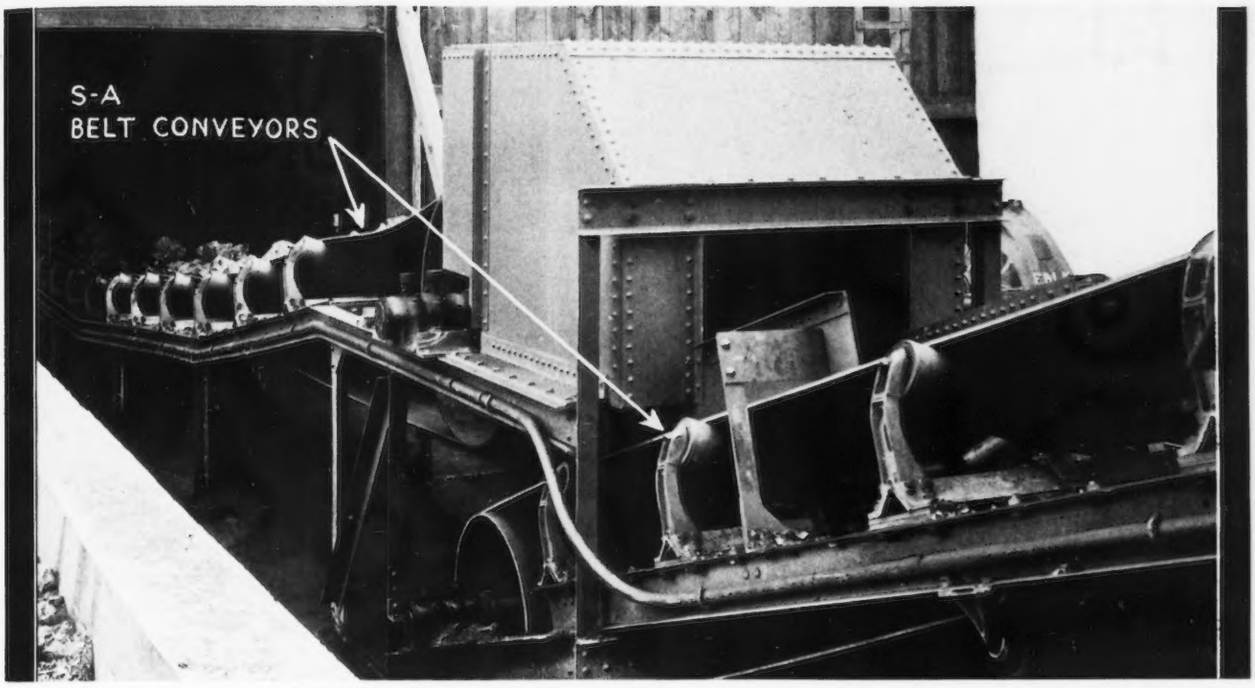

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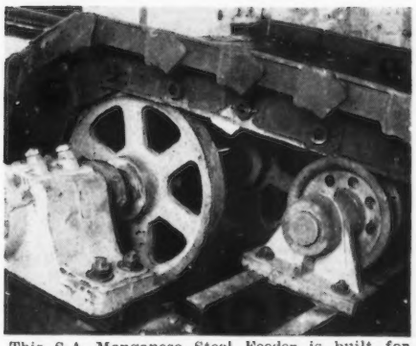

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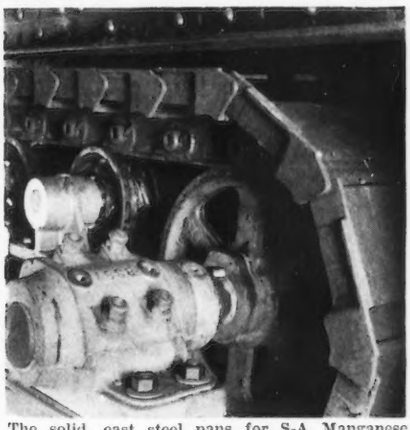

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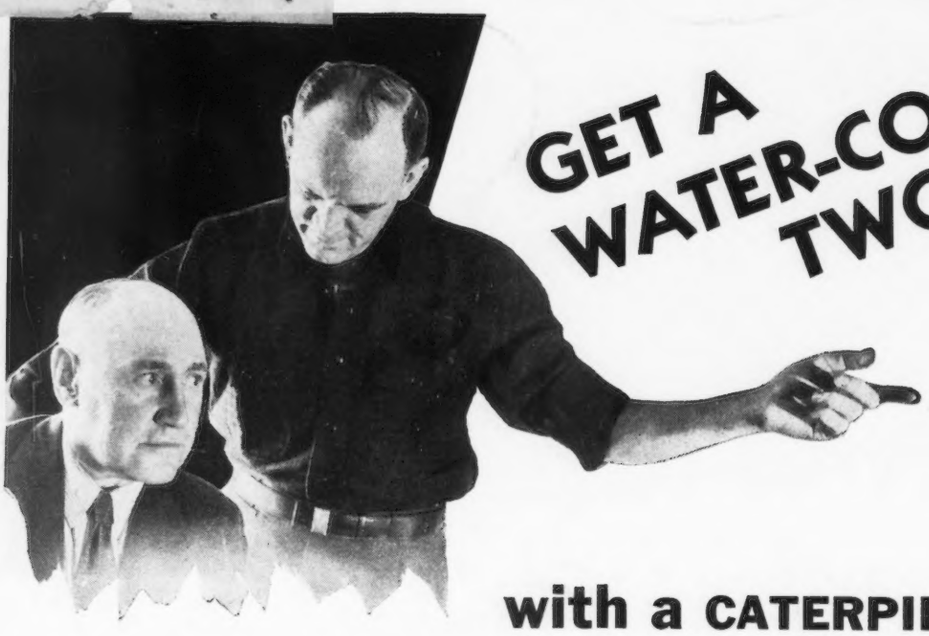

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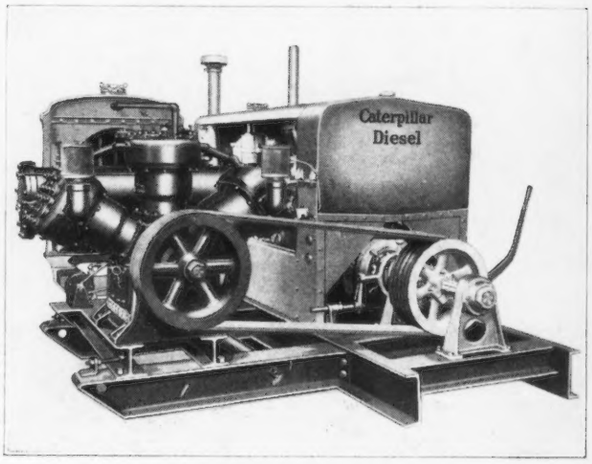

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